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Popular Science

Founded MONTHLY *1872*

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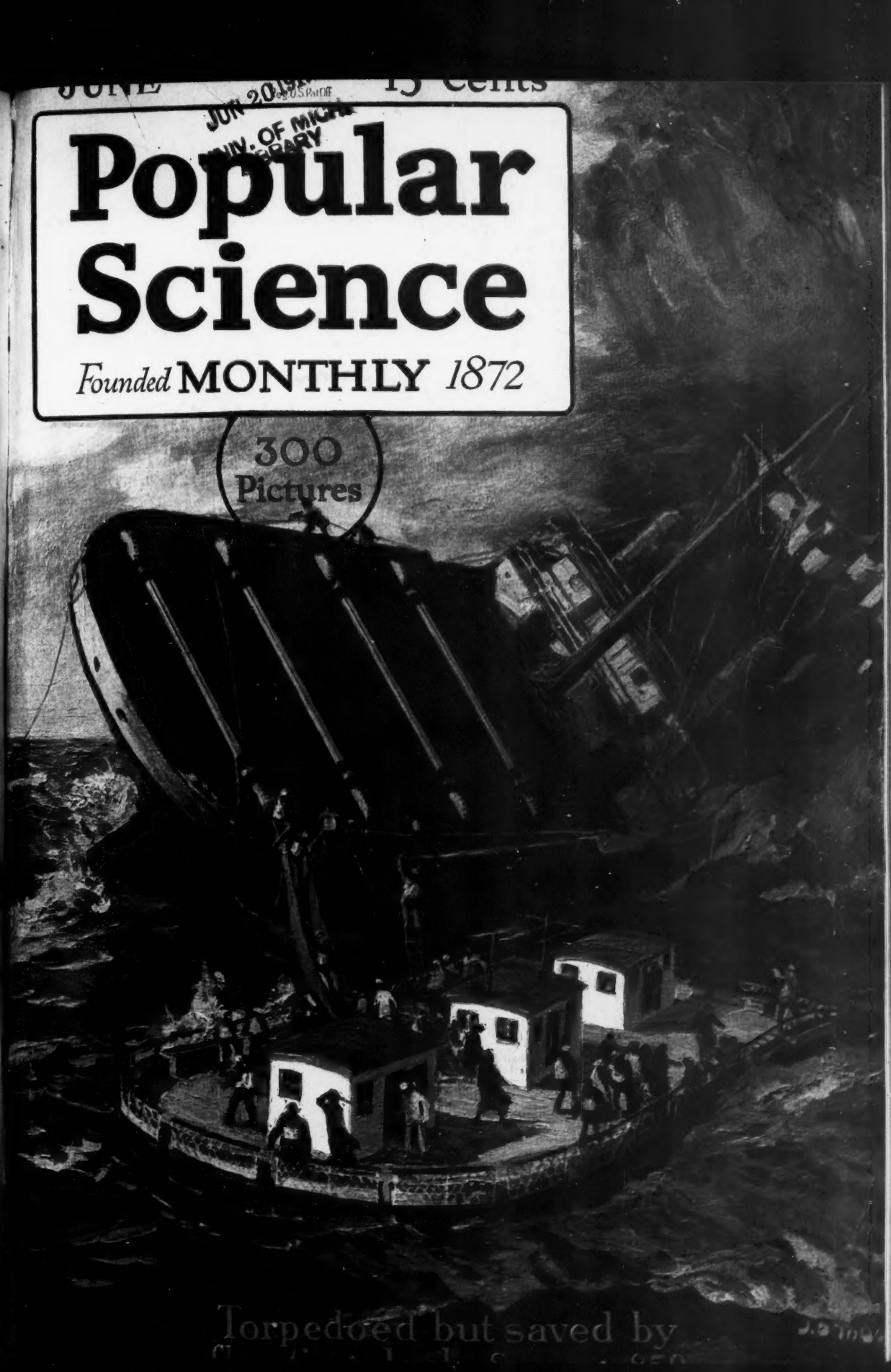

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Victor Supremacy
means–the greatest music by the greatest artists

It is indeed a wonderful thing to have the greatest artists of all the world sing and play for you right in your own home.

The instrument that accomplishes this inevitably stands supreme among musical instruments.

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The greatest artists make records for the Victrola exclusively. They agree that only the Victrola can bring to you their art and personality with unerring truth.

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Victor Talking Machine Co.
Camden, N. J., U.S.A.

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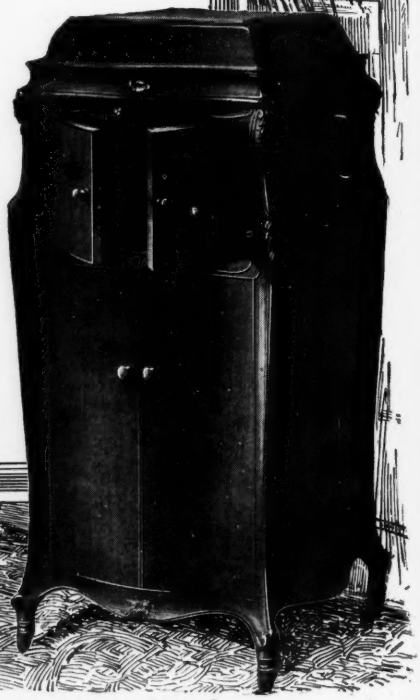
Victrola XVII, $250
Victrola XVII, electric, $300
Mahogany or oak



New Victor Records demonstrated at all dealers on the 28th of each month

Of all the magazine readers in America, probably no group would show so high a percentage of efficiency as the POPULAR SCIENCE MONTHLY family from the standpoint of our Country's need in the present crisis.

In the first place, a very large proportion of our many thousands of readers are young men—vigorous, intelligent, alert.

In the next place many—very many of our readers follow vocations which, from the economic standpoint, are vitally important to the Country's program of preparedness and conservation.

In the third place, where could you find so impressive a number of men—and women too—with the inventive type of mind? Who can tell what will be evolved from the experiments and discoveries of POPULAR SCIENCE MONTHLY readers and how far-reaching the benefits thereof to our Country?

We must, one and all, in whatever direction the path of duty lies, give the best that is in us, placing patriotism above selfish gain; self denial above personal indulgence.

Our Country is a land of liberty and opportunity. Let us search our hearts and our brains for those qualities whereby each one of us can best do his share towards preserving and upholding these priceless attributes.

Mere Firing of Guns Is Child's Play to This!

The cable is strung over small trees or hedges wherever possible and is buried when no other protection is available. If the men are not killed they accomplish their task at the rate of about six miles an hour; but the enemy artillery find the cable detachment an excellent target

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Laying Telegraph Cables Under Fire

How the British lay communication telegraphs in the field and in the trenches

By Captain A. P. Corcoran, late of the British Army

Readers of the POPULAR SCIENCE MONTHLY are by this time familiar with the name of Captain Corcoran. He has lately returned from the front where he saw the service that he here describes. He is the author of the article "Wireless in the Trenches" that appeared in last month's issue of the POPULAR SCIENCE MONTHLY.—Editor.

WITHOUT communication, of course, war could not be waged. For a while the electric flash lamp was used. It took the form of a small, four-volt bulb, placed in the barrel of a rifle. The rifle was sighted directly at the receiver, who was the only person in a position to see it. But this method of communication was too slow. Now the wireless, the telephone and telegraphing buzzer are used.

From General Headquarters up to Brigade Headquarters, the method of connecting up these instruments is by air-line. But from Brigade Headquarters up to Battalion Headquarters and all along the line of the trenches, cable has to be used.

A cable detachment consists of ten men, eight horses (four riders and four draft) and a wagon, the leader and the near wagon horse having drivers mounted. The wagon carries a number of poles for bridging crossings, and four drums of cable, each containing five miles of No. 14 insulated copper wire. The inside end of each drum is connected with the wagon and contact is made with a telephone on the box seat.

Suppose the cable is to be laid between points *A* and *B*. The loose end is paid out and man No. 8 (Nos. 9 and 10 being mounted on the draft horses) connects it with a telephone and remains at point *A* while the wagon moves off at a trot.

Man No. 1 now rides on ahead, to pick out the most suitable course to travel. Man No. 2 works the telephone on the wagon, constantly keeping in touch with point *A*. Man No. 3 sits in the wagon, easing the cable off the drum Nos. 4 and

© Int. Film Serv.

A telephone corps of the Fourth Division of Royal Engineers (British) picking up a message through a wagon telephone equipment

A switchboard in a crude dug-out with makeshift appliances, which rivals the most modern New-York-to-Chicago line in efficiency

5 likewise sit in the wagon, armed with mathook and spade, ready at any moment they come to a crossing to jump down and dig a small trench. This is usually four inches deep, the object, of course, being to bury the cable out of danger from passing vehicles or horse hoofs that might cut it. Having concealed it, the men tie each end to some standing object close to the trench, so that the cable will not be pulled out of its grave. That operation completed—it usually takes three or four minutes—the wagon again moves on.

Now behind the wagon there follow always two riders—Nos. 6 and 7, each armed with a crook stick. This consists of a piece of broom handle, fitted at the end with an iron hook, and is used to lift the cable on the tops of hedges or small trees or other objects which might help to keep it off the ground. With a lift of the arm, No. 6 swings the cable on high; but, should he chance to miss any of it, No. 7 does his work.

Should the wagon come to a very large crossing or perhaps a brook, the cable is not buried but borne overhead. In this case it becomes the duty of Nos. 6 and 7 to ride up to the assistance of Nos. 4 and 5. Between them they erect two poles, each eighteen feet high, one on either side of the crossing—an operation which takes five or six minutes at least, as the holes have to be jumped for the poles. The cables are laid at the rate of about six miles an hour.

In the trenches, of course, the method is entirely different. Since horses and wagons are not practicable, what is known as a "man pack" takes their place.

© Int. Film Serv.

British signal officer receiving communications, while he keeps his eye on the enemy

This pack consists of four men. No. 1, whose duty is to pay off the cable, carries his equipment strapped to his back. The cable is done up in a reel, consisting of about 2,000 yards of 18-gage, a smaller one than that used in the wagon set.

No. 2 leads the way, fixing little wooden pegs in the sides of the trenches. No. 1, of course, follows on behind, paying out his cable as he goes. Nos. 3 and 4 follow No. 1, their duty being to tie the cable to the wooden pegs affixed by No. 2.

In the trenches, naturally, there is always the danger that the cable may be cut through by shell fire. Various devices have been introduced to lessen this danger. The method of laying cable in loops, one of which will always preserve the contact, though the others be cut through, has been found most effective in actual fighting.

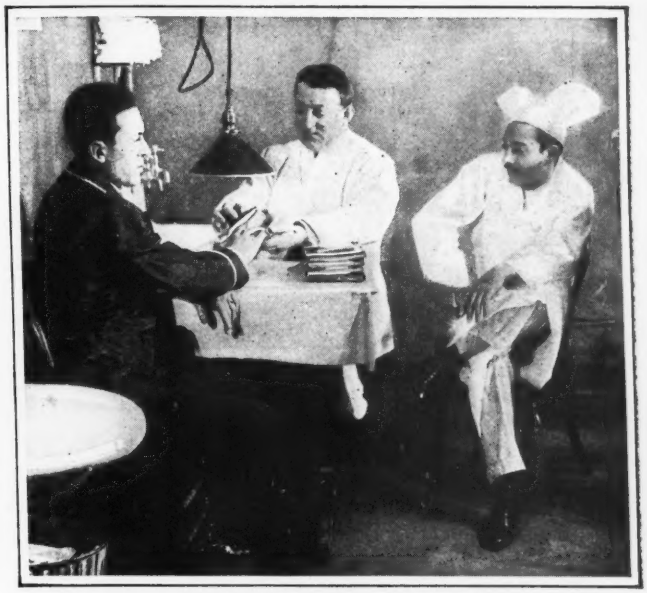
Technical and safe as all these tasks sound, they are nevertheless attended by their own difficulties and dangers. When the enemy artillery and airplane scouts are busy, they find a cable wagon an excellent target.

For instance, during the retreat from Mons, a cable wagon was sent out to reestablish communication between units severed during the retirement of the troops. Overhead circled a German airplane in search of prey. It got the first wagon. Another wagon was sent out. The airplane got it, too. Then a third essayed the task. And this one, all of whose men expected, of course, to be blown sky-high, succeeded, where the others had failed. Such is the luck of battle.

To my mind there is something pecu-

liarly romantic about the work of these telephone and telegraph men in France. To begin with, they are extraordinarily efficient. Suppose you want to get a message through from some tiny unit at Ypres to another equally insignificant at Albert — a distance of some one hundred miles. They will do it for you in less than four minutes. In New York or Chicago, with all modern appliances, with up-to-date, comfortable quarters, you could not obtain an equivalent connection in less time than that.

It may be romantic to do battle. Battle rouses your blood, and the instinct of self-preservation will always help you in a fight. No disparagement of the fighters—but I take my hat off to the man who can do a cable-laying job under fire.

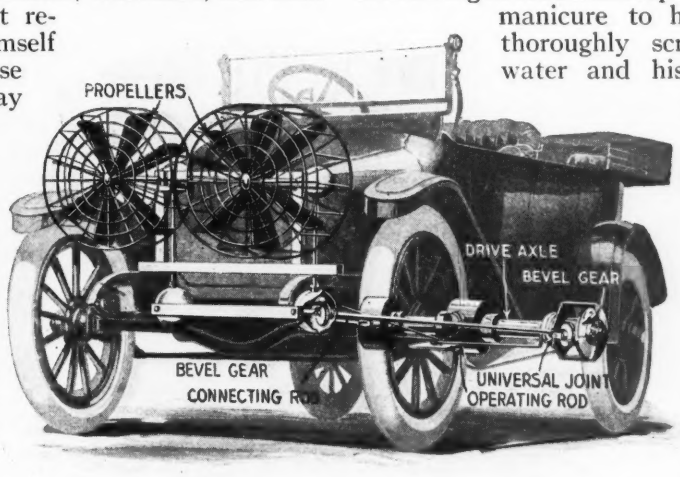


Gustave manicuring the nails of the employees of the dining-room, kitchen and pantry of a New York hotel with as much care as if they were patrons

Another Inventor's Idea for Speeding Up the Automobile

SOME patents suggest mainly the idea that somebody somehow is making a little money out of somebody by getting the patents issued. Until September 19, 1916, we could all, for example, freely mount two 42-inch, 8-bladed propeller-screws in front of our motor-cars and connect them with the hubs of the rear wheels by means of six pairs of bevel gears, two long rods and two universal joints; but on that date Edward Wintermute of Exeter, Nebraska, had such an arrangement reserved for himself alone and those on whom he may see fit to confer the same privilege.

The illustration shows one of the ways in which this conception can be presented by pen and ink without challenging the appointment of a commission in lunacy.



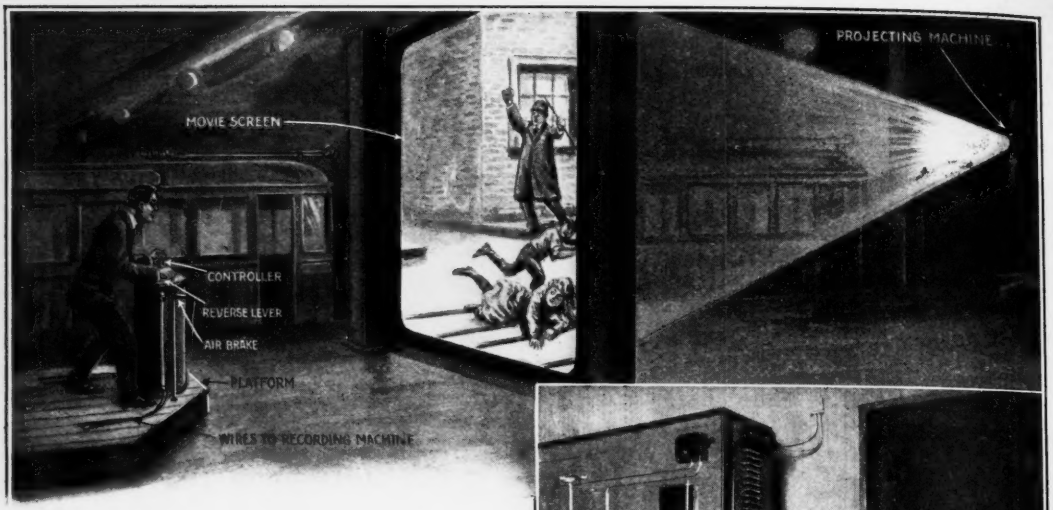
The propeller-screws in front of the car are intended to increase its hill-climbing ability seventy-five per cent

New York Restaurant Waiters and Cooks Must Now Be Manicured

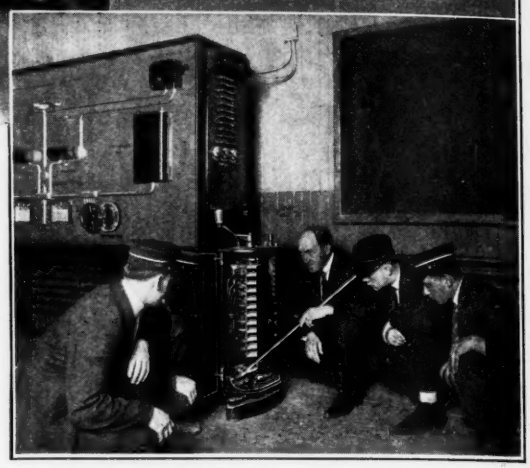
AMONG the many innovations which the age has produced, none seems more novel or extreme than one of the regulations in reference to health and hygiene recently introduced by the management of a great New York hotel.

Under the new rules, an official manicure has been installed to take care of the hands of the cooks and waiters. Every day each employee who is in any way connected with the serving of food must report to the official manicure to have his hands thoroughly scrubbed in hot water and his nails cleaned and polished.

The manicure is perhaps the busiest of the hotel employees. When his first duties are over, his task of inspection begins. At no time of the day or evening is a careless waiter or cook safe from his scrutiny.



The applicant stands on a platform close to the motion-picture screen with the controller and air-brake handles in his hands. He is supposed to operate them just as he would if he were on a car on the street



The controller and brake levers are connected with a tape recording machine. Moving the handles causes two needles to trace lines or curves on the tape. At right are the examiners watching the tape

Testing the Motorman's Quickness and Skill

The speeding automobile, the busy street and the excited crowds are brought into the testing room—on the screen

THE instructor in charge of a Brooklyn school for motormen, which is maintained by one of the street railway companies of that city, has devised a test for ascertaining the efficiency of motormen by means of a motion picture screen and a clockwork tape-printing mechanism.

The test, in some respects, is similar to that which is used in determining the reliability of French war aviators which was described in the October number of the POPULAR SCIENCE MONTHLY.

In the test for French aviators, the candidate's quickness in responding to certain sensations, such as sound, sight, and feeling, was carefully recorded.

The quickness and accuracy of judgment of a motorman at the controlling handle of a street car traveling at high speed when an automobile darts around the corner and down the track would determine his fitness for the job.

The accompanying drawing shows the arrangement of the testing apparatus. On the platform before the motorman-applicant is mounted a regulation-sized street car controller and air-brake lever. Half-way down the room facing him is a moving picture screen. Back of the screen, at the other end of the room, is the projection machine. The controller and brake levers are connected electrically with a tape-recording machine. The tape is about three inches broad and is marked by two self-inking pens. Moving the handle of the controller or the handle of the air-brake causes two needles to move, tracing irregular lines, or curves, along the tape.

As soon as the picture is flashed on the screen, the applicant is ordered to operate the two handles as if he were actually on the platform of a street car. The picture, taken from the platform of a moving car, shows an assortment of contingencies.

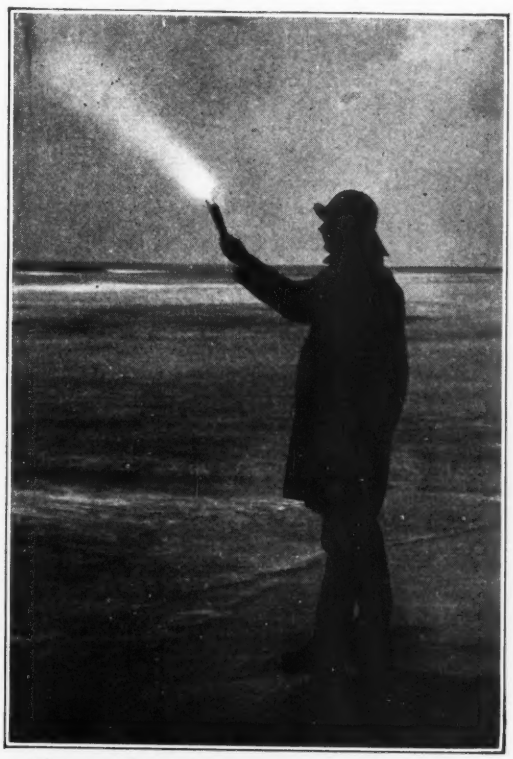
Beach Patrol of the Coast Guard

THE efficient beach-patrol system maintained by the United States Coast Guard for the protection of mariners was originated in the early 'seventies by what was then known as the Life Saving Service. It is in operation by night, from sunset to sunrise, and also by day when the weather is thick or foggy.

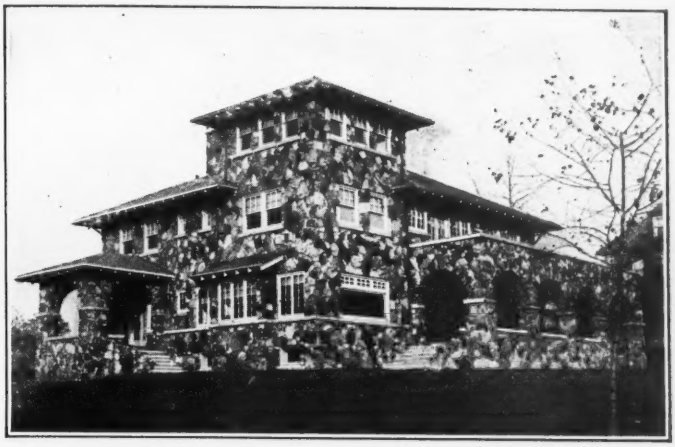
The crew at each Coast Guard station is divided into watches of two men each, who are charged with the duty of patroling a regular beat, laid out in each direction from the station along the shore, and varying in length, according to the conformation of the coast, from one-half to four miles. The patrolman is expected to keep a sharp lookout to seaward.

While the patrolman is out on his beat, his watch-mate takes the station watch, which is kept in the tower or on the beach abreast of the station. Besides keeping a watch seaward, the station man is on the lookout for signals from the patrolman. When the latter, having covered the beat in one direction, returns to the station, he takes the station watch, and his mate patrols in the other direction. In harbors and seaports, fixed lookouts are usually maintained instead of a beach patrol.

Every patrolman carries a supply of red Coston signals, with which to give warning to vessels standing too close inshore, or to notify a vessel in distress that he has gone to summon the necessary assistance.



The patrolman keeps a sharp lookout to seaward while his watch-mate guards the station



No two of the stones in this house are alike. They were gathered from all parts of the world and each has a history

A "Crazy Patch" House Built of Stones from Everywhere

THE "crazy patch" house of David F. Brown, in Punxsutawney, Pennsylvania, is composed of stones from all parts of the world. There are stones from every State in the United States, stones from Italy, Ireland, China, Japan, South America and other places innumerable. Grindstones, millstones, stones from the Mammoth Cave, from Pike's Peak, from the home of Patrick Henry, from the spot on which General Lee surrendered and from every historically famous place in this country, go to make up the "crazy patch" house. Over the fireplace is a piece of gold quartz from South America.

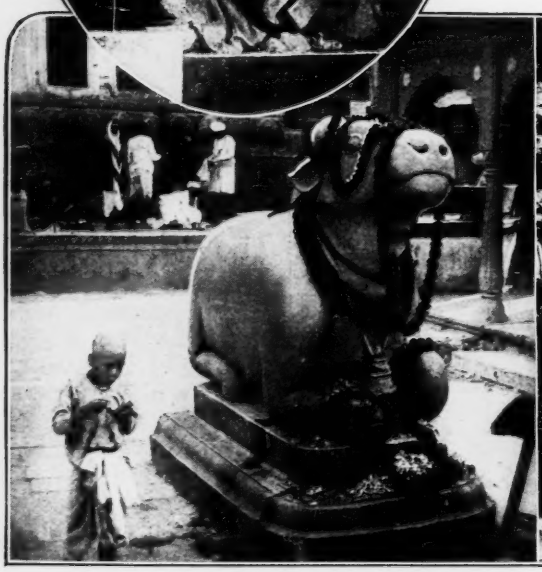
It required two years to build the house, but Mr. Brown and his friends and relatives who knew of his hobby for collecting odd stones, spent much more time than that getting the necessary number of stones of which no two were alike.

Rudyard Kipling's "Bloomin' Idol Made o'

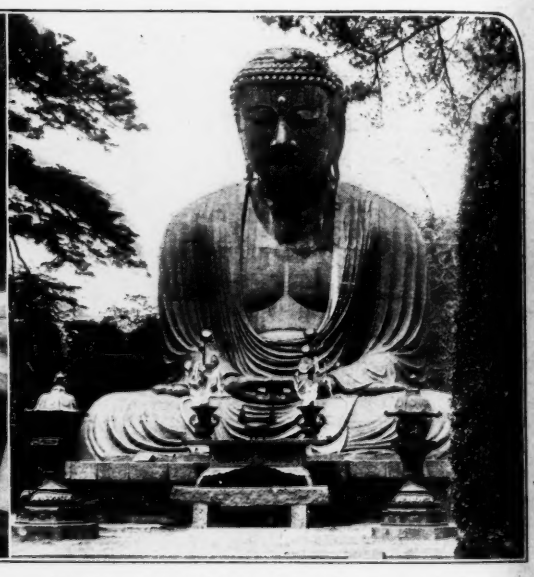
Photos © Newman Traveltalks and Brown & Dawson

The original religion of Japan is a mixture of nature-worship with ancestor-worship, but Buddhism has a strong hold too. Above is shown the thirty-three stone Buddhas of Nikko, splotched over with paper prayers pasted on by pilgrims

In China, Confucianism is the principal religion. It is a moral system which refuses recognition of the unknown and emphasizes the duties and joys of the present and especially of the home and family. At left is the God of Happiness, of Canton



One of the chief characteristics of the Hindu faith is the acceptance of the cow as a sacred animal. Above is the Golden Bull, of Benares, India, which is greatly reverenced



The finest "Buddha" statue in the world is at Kamakura, India. It is of bronze and is nearly fifty feet high. The forehead pendant is of silver and weighs nearly thirty pounds

Japan —

Mud—Wod They Called the Great God Budd—"

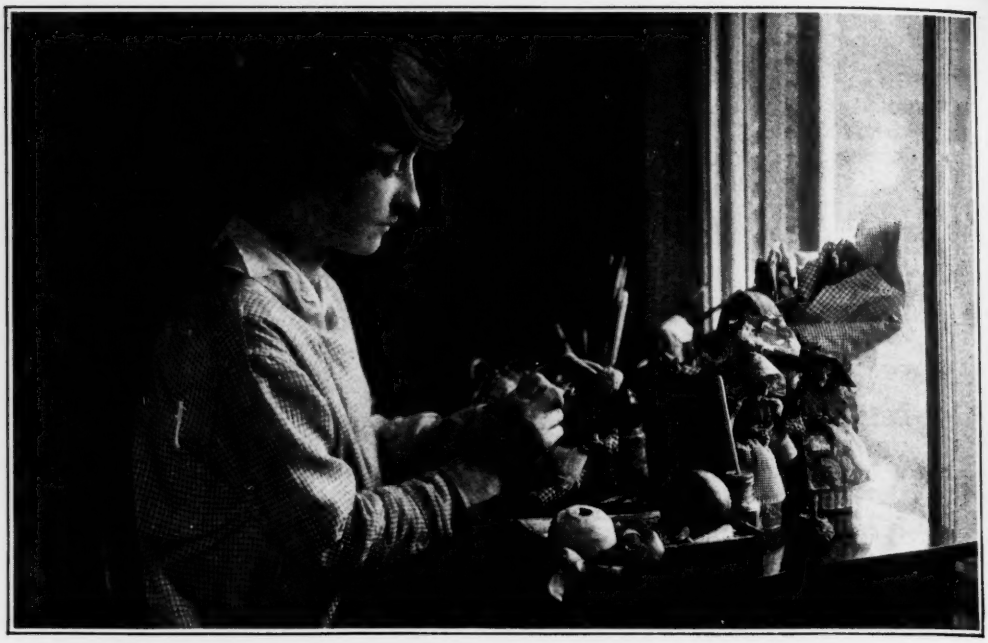
Photos © Newman Traveltalks and Brown & Dawson

India boasts of nine specific religions and almost innumerable gods. Above is the terrible God of Thunder and Lightning with his thunder-bolts in hand. The image is made of bronze with ivory teeth and horns. Glowing rubies represent the eyes. During the hot, dry season, which begins in March, the Hindus begin making sacrifices to this fiend-god so that when the rain does come it may not do more harm than good, as is sometimes the case in this land of climatic extremes

In a niche in the entrance hall of the Temple of Iyeasu, Japan, is the exquisitely carved golden demon-dog Wo, which is shown in the photograph above. It is a terror to thieves

Usually the gods and goddesses of plenty carry fruits and vegetables in their hands, but this Chinese god measures abundance in jewels and gold in a very occidental manner

A New Art—Dried Apple Sculpture



Miss Isabel Million, of Knoxville, Tenn., reproducing her "Po' white" mountain acquaintances from dried apples. How she prevents the apples from withering further after she has carved them is Miss Million's own secret

Photos © Press Illus. Serv.

A faithful portrait of Harbe Hawkes and his "ole woman." He raises "taters" while she patches quilts. Both are a little rheumatic, but otherwise "mid'-lin', thank ye"

Tobe Lemons of Smokey Cove has a misery in his "chist" which prevents him from making an honest living. He is just strong enough to peddle whiskey

A type often met with in the mountains of the South. She makes rag carpets and lye soap for a living and is saving to buy a set of store teeth—a wonderful luxury

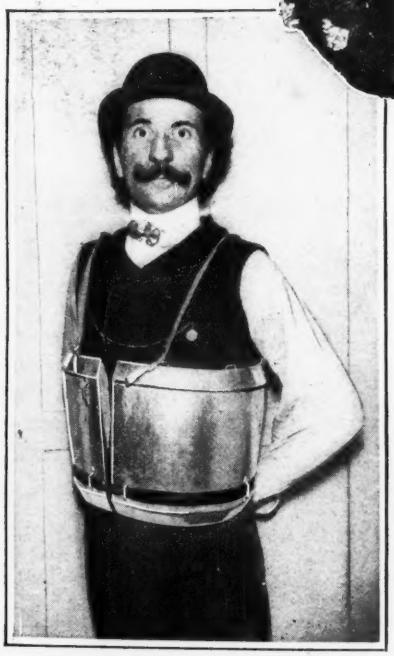
It is wonderful the amount of expression and the detailed history which these little figures reveal. Here is the village seamstress going to church dressed in "Sunday" clothes

Eluding the Customs Inspectors of Paris

Below: Customs inspectors were attracted to a lawyer who carried his portfolio under his arm instead of by the handle. It was found to contain a bookshaped vessel filled with dutiable liquor

Above: A roll of goods with a hidden compartment in which liquor or other dutiable commodities may be hidden. Trucks loaded with such rolls are often seized

A funeral wreath made over a hollow cylinder. None but the most cold-blooded would suspect it as a carrier of liquor

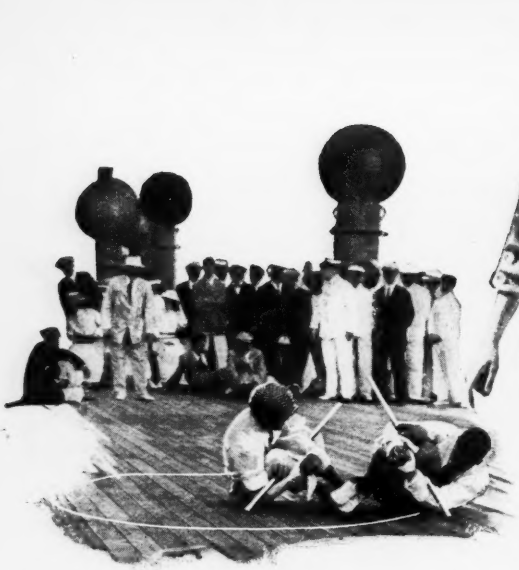


This man looked like a prosperous merchant of generous proportions; but the inspectors soon found that he wore a whiskey-filled cylinder under his coat

The convenience of a tubular horse collar could never be overlooked by the liquor smugglers

The face of the woman above was too youthful for her waistline. It was found that she wore a rubber petticoat stocked with the most expensive liquors

All Play and No Work Tends to Make the



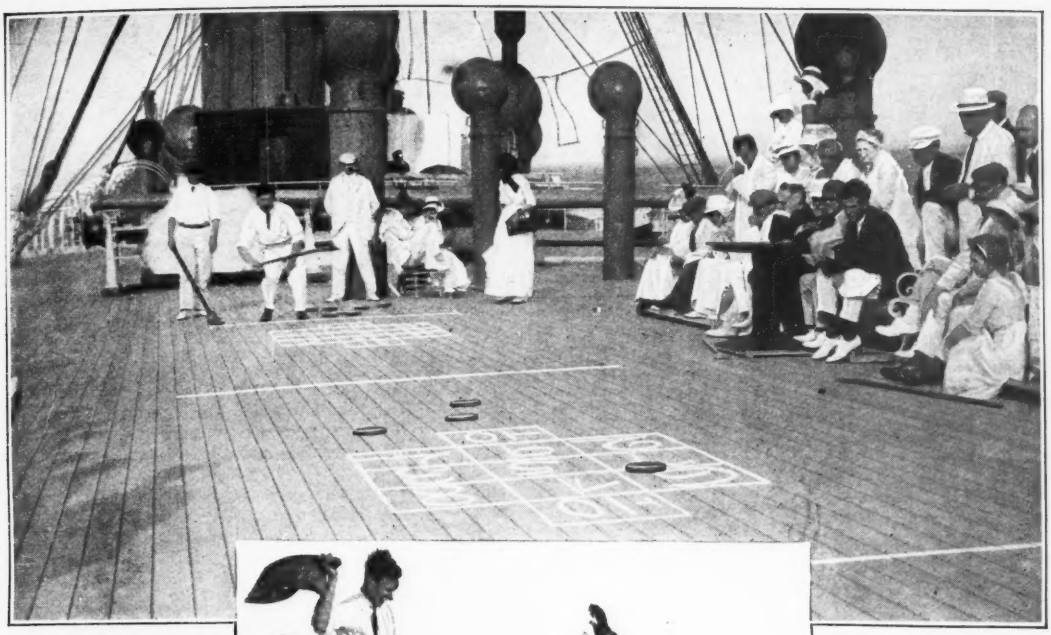
A sport for energetic youths. Keep your sitting position and stay in the chalked ring—if you can. The pushing is done with the feet alone and only rubber and canvas shoes can be worn

Riding turtles affords an exciting moment or two. The turtles don't mind it and the riders think it great sport. The turtles will be served up later for soup

Photos © Brown and Dawson

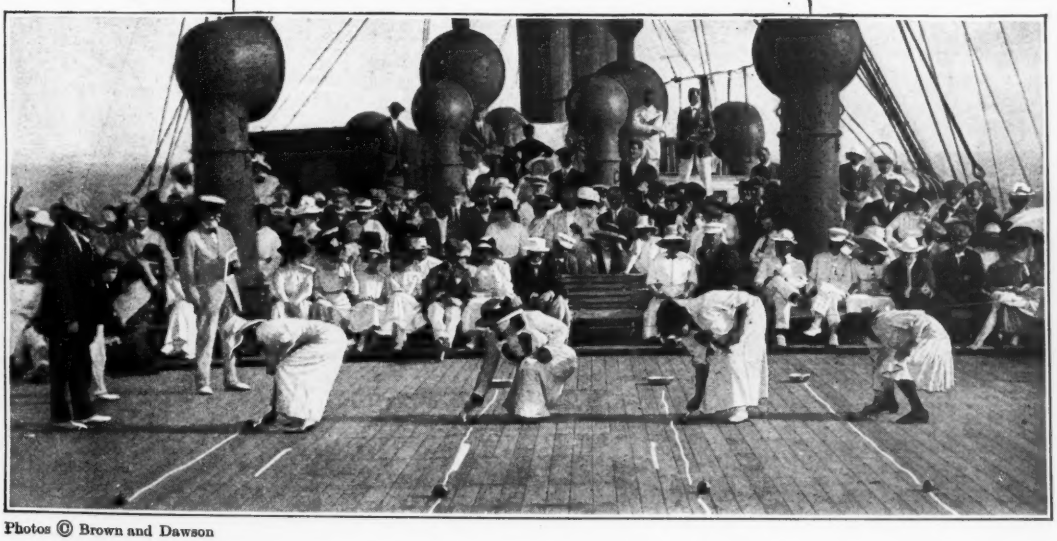
The bottle race is the grown-up's "play horse" game. The men are blindfolded and the women drive them in and out among the lined-up bottles which are spaced about two feet apart. The champion bottle-dodging team is the one which fails to knock down a bottle

Ocean Voyage Take On a Carnival Appearance



Shuffleboard is the aristocrat's game. The aim is to shove wooden disks with a cue into the divisions marked off on the deck. It has been called salt water golf

What the onlookers like—the cock fight. One man has a pillow with which he belabors the other and tries to break his partner's hold of the pole without losing his own balance



Photos © Brown and Dawson

The potato race is the child's delight and the old maid's Waterloo. The potatoes are picked up one by one and deposited in the dish or receptacle at the end of the line. The one who carries all the potatoes in her line to the dish in the shortest time is the winner. The captain keeps the score

"Preparedness" Includes Women Wireless Operators

The code room of the Girls' Wireless School at Hunter College, New York. The students are instructed and drilled in every branch of wireless work

Photos © Underwood and Underwood

Miss Margaret M. A. Donahue, of Boston, Mass., the very first woman in the United States to receive a first-class license for commercial radio operation

The laboratory at the wireless school at Hunter College. The apparatus and appliances are up-to-the-minute and complete in every detail. The girls have offered their services to the Government

Training Four-Footed Red Cross Recruits

The military dog has at last come into his own. The present war has proved him to be a most efficient messenger and patrol. At right is shown a courier who knows no fear

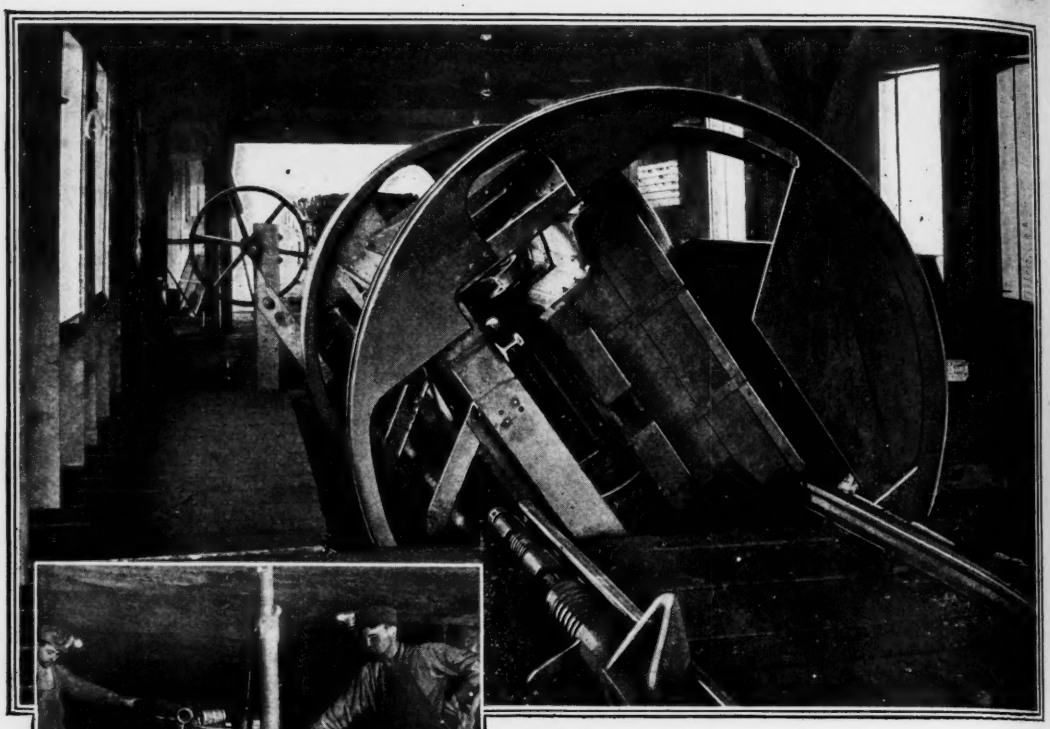
At left: Mrs. L. P. Warner who has established a training camp for Red Cross dogs at her home at Hempstead, Long Island. With her is Filax, a "star" winner

At right: Practising the high jump at the training camp. The majority of the dogs used are sheep dogs and wolf dogs, although hounds, collies, and airdales are also apt

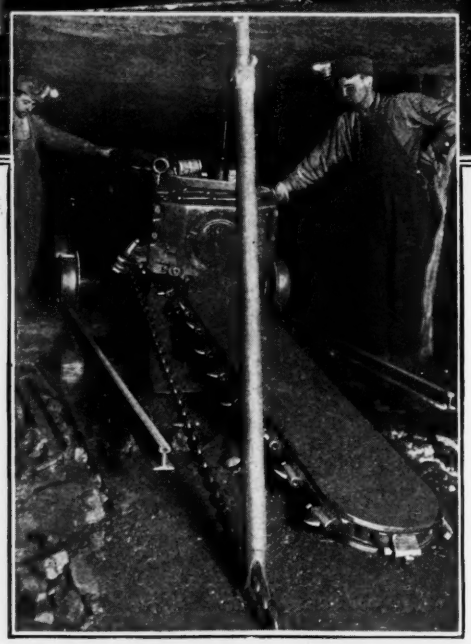
Photos © Amer. Press Assoc.

The dogs become very proficient in locating the wounded. They are taught to bring back some article of clothing from a fallen soldier, such as a cap or handkerchief. When they return with no token it is safe to conclude there are no wounded left in that section of the field

Coal Mining Machinery Has Increased Our



Four cars of coal are unloaded every minute on the rotary dump. The coal falls into a conveyor which leads down the mountain to the tipple house. There it passes over shaker screens and is graded according to size

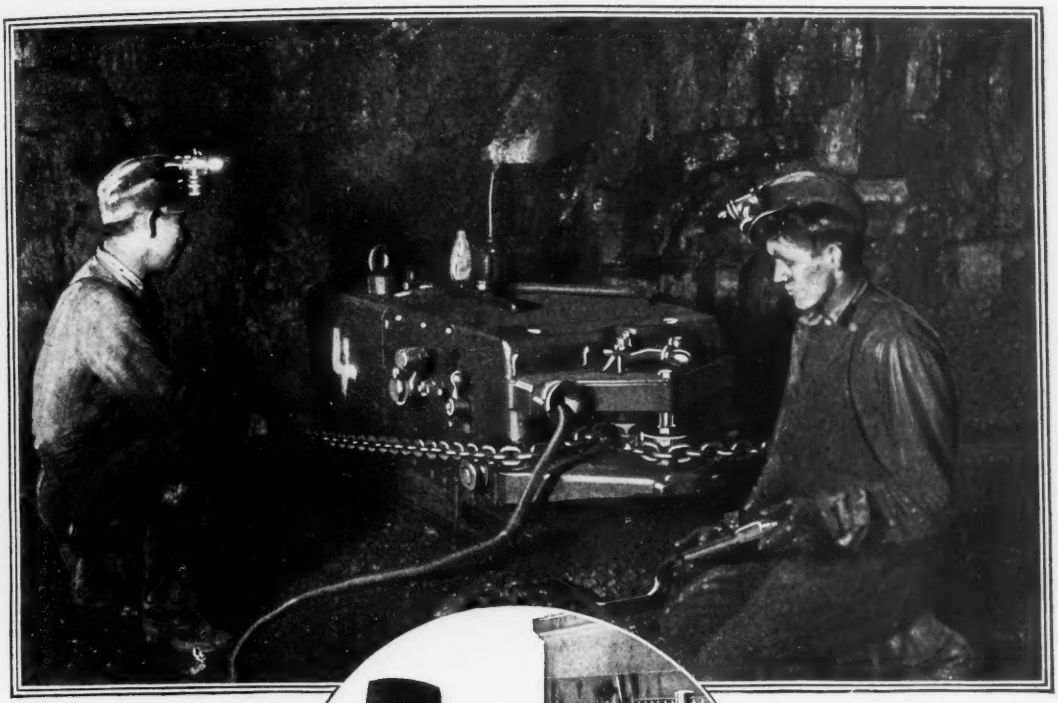


At left: A modern mining machine for undercutting coal. It is driven by electric current and the teeth or picks travel on a chain around the cutter bar. The first cut is always made at the level of the ground

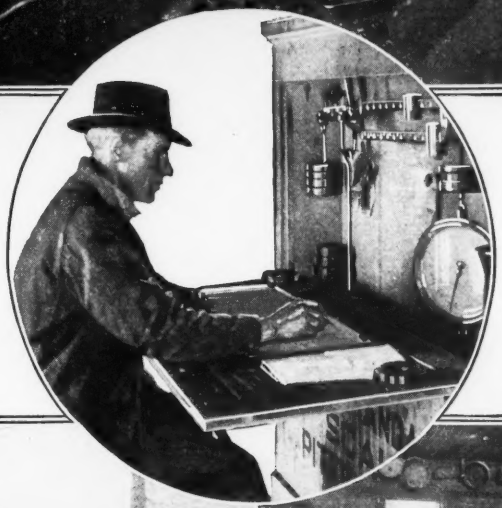
Photos © Press Illus. Serv.

Mountain women come to the mining camp to trade their eggs, butter and chickens for coal and other merchandise. Traveling is done on horseback and with pack-mule since the mountains are too rugged for wagon roads

Coal Output Fifty Fold in Twenty-five Years

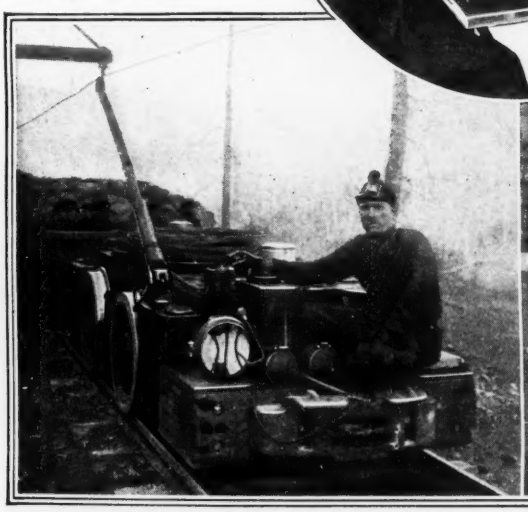


The coal-cutting machine, cutting to a depth of six and one-half feet at the rate of eighteen inches a minute. The miner with the shovel is clearing away the "cuttings"



As each pit-car passes on the rotary dump it is automatically weighed and the tonnage listed by a man who does nothing else but attend to the weighing

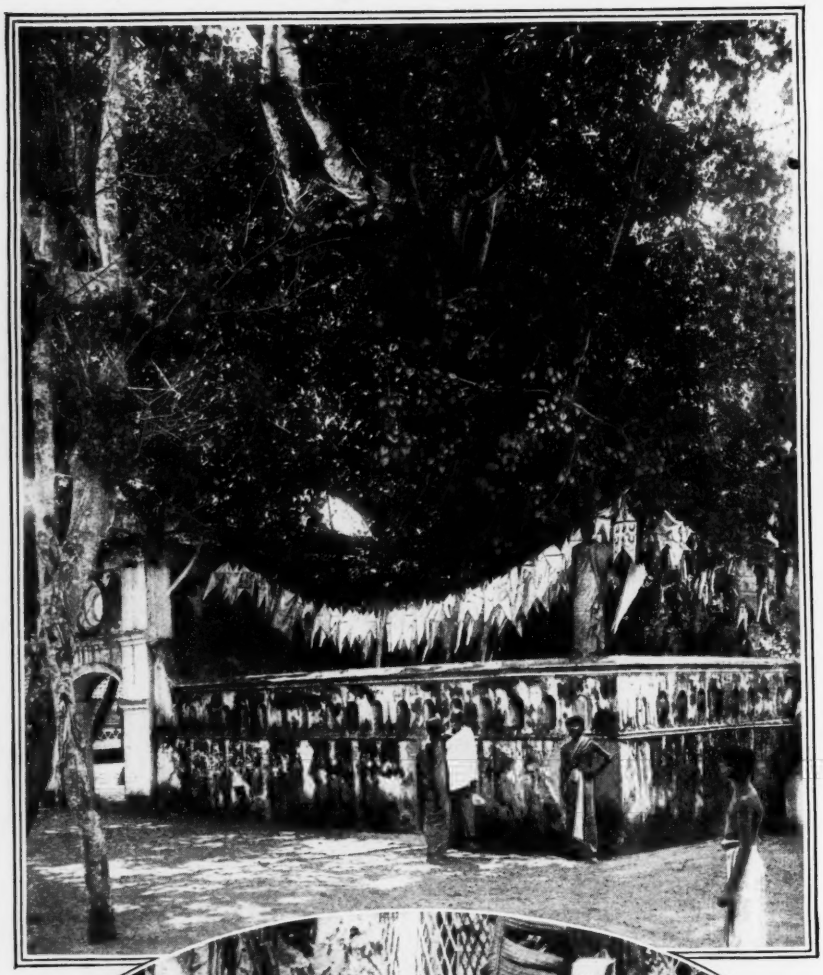
Photos © Press Illus. Serv.



A modern electric locomotive used for hauling coal from the mines to the dumping house

Miners trading in a cooperative store where practically everything can be purchased

Superstitions of Chinese Gardens



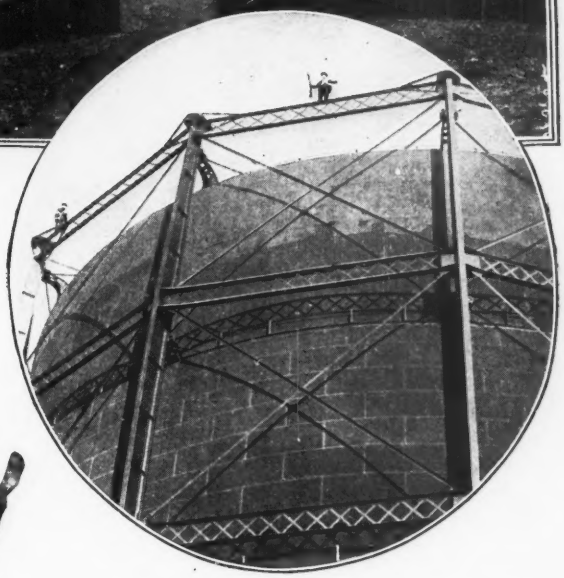
Tree worship is common in the East. The photograph at left shows the sacred Bow Tree of Ceylon. It is found in the gardens of the temples all through China. The little flags hung on strings around the enclosure were placed there by pilgrims and doubtless represent prayers

Below: Manikins dressed in growing shrubbery as decorations in a garden of one of the gambling kings of Macao, China. The evergreens are planted in the flower-pot bases and are trimmed into form every few days. The manikins are life-size

Photos © Newman Traveltalks and Brown and Dawson

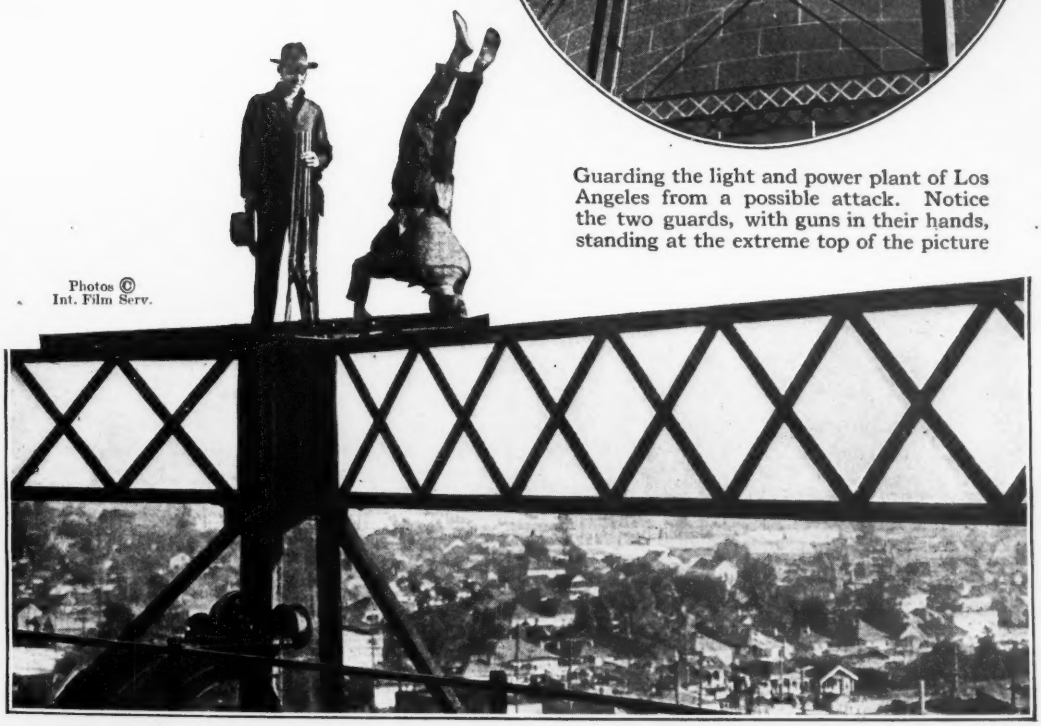
Guarding Property from Cranks and Incendiaries

A watchman's tower, equipped with two searchlights, which overlooks the plant of the Midvale Steel Company. All approaches to the buildings are bathed in artificial daylight at night to ward off spies and incendiaries



Guarding the light and power plant of Los Angeles from a possible attack. Notice the two guards, with guns in their hands, standing at the extreme top of the picture

Photos © Int. Film Serv.



One guard holds the weapons while the other performs a dare-devil stunt for the benefit of the photographer. These men have to guard the huge gas tank by walking around its top girder

The Two-legged Shops of the Tropics

Merchant burden bearers in the streets of Japan. The size of the load and the variety of the stock are only limited by the strength of the peddler

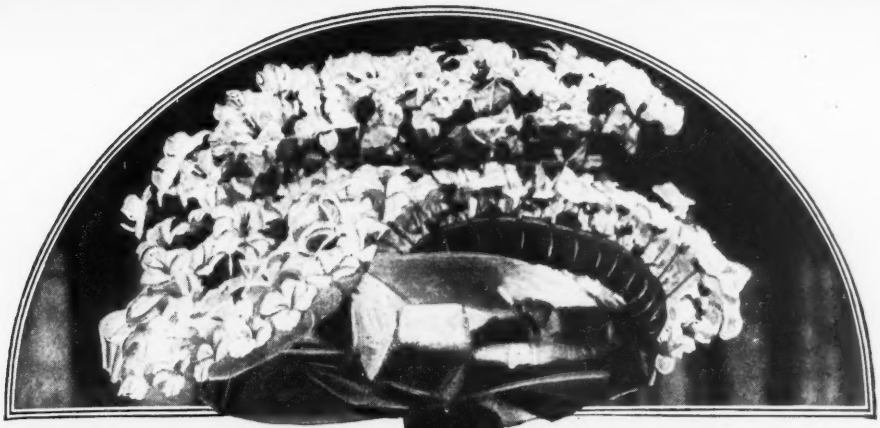
Photos © Newman Traveltalks and Brown & Dawson

Lemonade venders are as numerous in Jamaica as hucksters on New York's East Side. On the balanced kettle there is a spigot which you turn and help yourself

The flower vender above goes about the streets of Rio de Janeiro balancing the heavy load of growing plants on his head and shoulders until he disposes of it

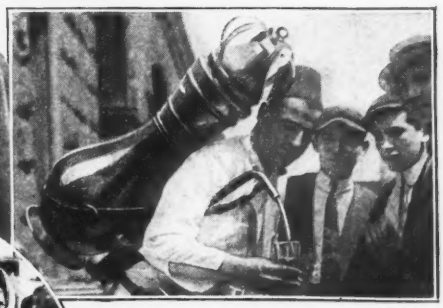
We are not unfamiliar with the vender of brushes and brooms on the suburban streets of our own United States; but in Rio de Janeiro he adds chairs to his stock

They Carry Their Shops on Their Heads and Their Backs



A typical street sight in South America, a vender balancing what seems to be a perfect garden of artificial flowers on his head

In Trinidad they sell pipe tobacco by the yard or in smaller strips



In Bayard Street, New York, as in Egypt, the beverage that cools comes to you

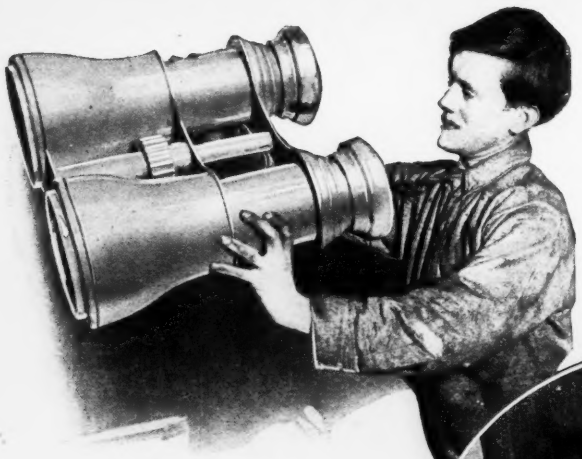
Selling beads in Cairo is a lucrative business for the street boys and girls

At left: An umbrella is part of the equipment of the peddlers of Korea

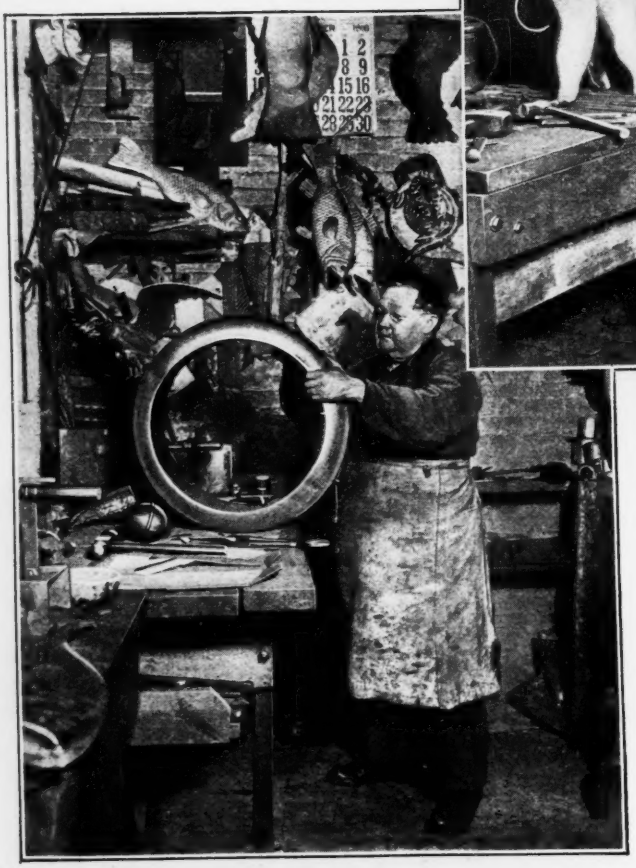
A bread seller of Barbados carrying her tray of bread and cake, and her chair

Photos © Newman Traveltalks and Brown & Dawson

The Most Curious of Curiosity Shops



In New York City is one of the most curious shops in the world. It is a factory where colossal models are made from metal for shop-keepers' signs. At left is a pair of opera glasses large enough to fit Miss Liberty. Sheets of copper were rotated against wooden models and blunt tools pressed them into form



This giant tooth is made of a composition substance of white appearance so that the dentist's sign will not tarnish or grow dim. As it is to be suspended overhead, it is made hollow inside so as to prevent it from being dangerously heavy if it should happen to be blown down

At left is a jeweler's sign—a wedding ring as large as an automobile tire. Others have been made large enough for diminutive couples to pose seated on the rim. No idea a merchant may have for an advertising design, however freakish, is too difficult for these metal workers

An Advertising Sign Factory Showroom

The rooster in the picture on the right will soon be the weather-vane on a very large building. Although substantially welded, it is not in one piece. Fully a dozen parts were made so that the completed bird might be an exact image of the real in every detail. Then the parts were assembled and soldered together

Animals of every description, jewelry of all kinds, eyes of every size and color, miniature automobiles, battleships, houses—in fact replicas of any and everything are made upon demand, so that the showroom of the factory resembles an old curiosity shop or a museum

Bird forms are hammered out on iron patterns which are cast from the original artist's model. Often the stuffed bodies of real birds are used, where the reproduction is to be life-size. The eagle in the picture on the right is made of hammered brass resembling polished old gold

The Birth of a Butterfly

A miracle which you may watch free of charge

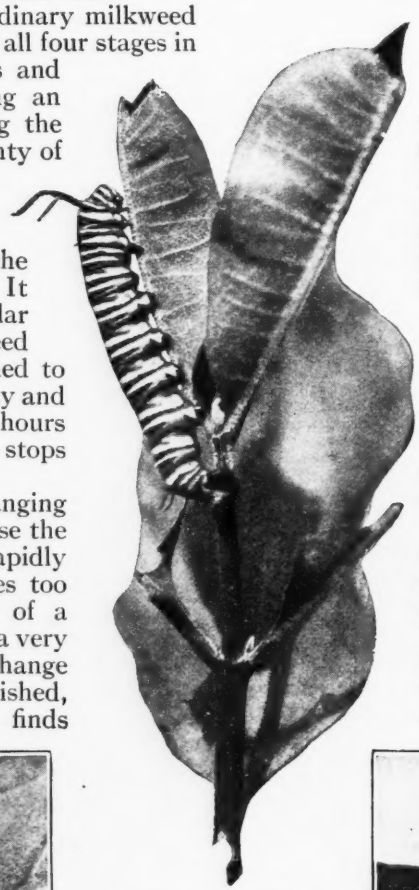
ALL butterflies must pass through four stages: first the egg; second the caterpillar or larva; third the pupa or chrysalis, and fourth the perfect insect or imago. Some species require months to complete the process. Many pass the entire winter in the third, or chrysalis stage, wound up in cocoons or buried in the ground or under stones or loose bark.

But the monarch, or ordinary milkweed caterpillar, passes through all four stages in from three to four weeks and has no objection to being an object of attention during the whole time, so long as plenty of fresh-cut milkweed is provided. Without this it would soon die, for the milkweed leaf is the only food it will take. It spends its entire caterpillar existence on the milkweed plant on which it happened to be born, eating greedily day and night except for a few hours every second day when it stops to change its skin.

This molting or skin-changing process is necessary because the little creature grows so rapidly that the old skin becomes too tight, like the breeches of a rapidly-growing boy with a very large appetite. The change itself is quickly accomplished, although the caterpillar finds it necessary to remain perfectly motionless for fully two hours before and after the process. The skin simply splits down the center of the back and the caterpillar crawls out fully clad in a new suit just like the old one, only more comfortable. This happens five times during its caterpillar stage of existence.

If you want to witness the miracle of the caterpillar's transformation, simply break off the stem of the milkweed plant on which you find the next caterpillar you happen upon, and place the end of the plant in cool water. Be sure and place a fresh stalk in the water bottle each day so that your guest will be well supplied with food, but let the caterpillar crawl to the fresh stalk unaided. Handling may injure it. It will not try to leave you so long as you provide plenty of milkweed.

The indications of the end of this first stage of existence will be a restless crawling about on the plant. The caterpillar is looking for the safest place to stay during the next stage of its career. Doubtless the spot

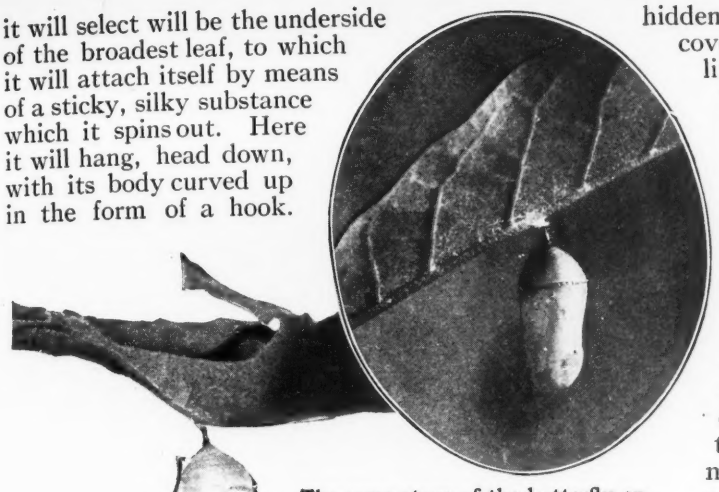


The monarch, or milkweed caterpillar which completes its transformation in three weeks

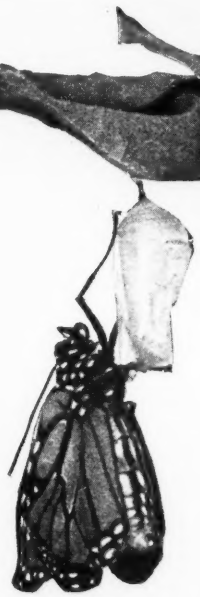
At left: The caterpillar attaching itself to a leaf by means of a sticky, silky substance

The pupa emerging from an outgrown skin. The old skin is split open and dropped off

it will select will be the underside of the broadest leaf, to which it will attach itself by means of a sticky, silky substance which it spins out. Here it will hang, head down, with its body curved up in the form of a hook.



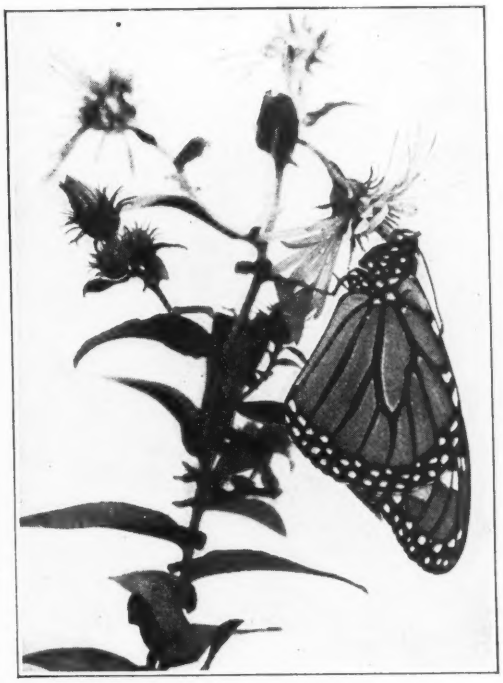
The pupa stage of the butterfly existence. It hangs thus for about twelve days, the shell gradually becoming more and more transparent



The newly-emerged butterfly. Its body is over-large and its wings much crumpled but as the wings slowly unfold the body decreases

After about twenty-four hours the body straightens out and begins to twitch and wriggle as if the little creature were in great pain. The head and upper portion of the body begin to swell. Finally the skin bursts, revealing the beautiful pupa or shell in which the rest of the transformation is to take place.

The old skin is dropped off and for three hours the pupa hangs like a little jewel bright green in color and ornamented with a circle of golden spots near the top. Perhaps you have spied one of these little milkweed jewels during your rambles; but common as they are, they are so well hidden that they are seldom discovered. You may leave your little guest now for from ten to twelve days, for although there is a wonderful change going on inside the shell there will be nothing you can see until about ten hours before the end of the process. Then the shell will begin to change in color from green to brown and will become transparent. You will be able to see the folded wings of the butterfly inside. The time has now come when you must watch closely or you will miss the most interesting part of all. Without a moment's warning the shell bursts and the butterfly emerges — a creature all body and with small, much-crumpled wings. The actual time consumed in the emergence is less than one minute. At first sight you may think that something has gone wrong, for the little creature certainly looks deformed and not at all like the beautiful butterflies that we see hovering about the flowers in the fields and gardens. But slowly the wings unfold, and as steadily the body grows smaller, for the life forces are being pumped from the body into the wings which are to be the crowning glory of the new existence.



The perfect butterfly. The last hour before it finally soars away from the milkweed stalk sees the most rapid change of all

While the wings are drying, the little creature timidly tests them, opening and closing them slowly until, gaining courage as the wings grow stronger, it soars out into its new life, a new creature gorgeously beautiful and entirely forgetful of its former groveling worm-hood. The miracle has been accomplished under our very eyes and yet we can scarcely credit it.

The Wasps of a Modern Fleet

Torpedo boat destroyers sweep upon a warship and torpedo it before it has a chance to retaliate. As scouts, they have proved indispensable

A TORPEDO boat destroyer is no longer, as its name seems to indicate, primarily a destroyer of torpedo boats. It is a fast torpedo boat of large size and capable of making prolonged cruises on the seas. Its preeminent purpose is to bag big game, such as dreadnoughts, by torpedoing them. Its most important armament is torpedo tubes which it carries on an aft deck on both sides of the ship. A number of rapid-fire guns of small caliber are also mounted on the destroyer. These are for fighting with swift, powerful destroyers like itself and for attacking submarines. Such performances, however, are incidental. The sinking of a huge warship during a battle is of greater importance than separate quarrels amongst small vessels like itself.

The Destroyers Lead the Way

A number of torpedo boat destroyers accompany a fleet into battle. They are always foremost in the fray. Led generally by a fast light cruiser, the torpedo destroyers sweep down upon the enemy's warships at a speed of forty miles an hour. The cruiser endeavors to ward off the counter-attacks of the enemy's lighter craft and strives to break a way for the destroyers that follow her, so that they can maneuver into firing position. The destroyers' work, however, is hazardous, for just one well-aimed shot will send one of them to the bottom. But, on the other hand, they are able to dash about here and there rapidly enough to baffle the enemy's fire.

This initial attack happens before the real battle begins. The slower battleships of the main fleet steam up and open fire upon the big ships of the enemy. Now the destroyers swarm about the battleships, "stinging" whenever they can. Their torpedoes can be launched with facility as the firing tubes, after being once loaded and aimed, operate automatically. The torpedo tubes are swung into firing position around their circular track which is mounted on the deck. Each torpedo tube is aimed by sights which are somewhat similar to those on any naval gun. An electric control is thrown in, then compressed air enters the rear of the tube and sweeps the torpedo out automatically.

The usefulness of these wasps goes even further than this. A destroyer continually tries to get to leeward of the enemy fleet, where she turns off the draft of her boilers. Clouds of smoke are immediately emitted, which the wind blows towards the enemy, and which soon envelope the enemy's ships. The enemy is temporarily blinded by the screen of smoke produced by the destroyer though the tops of his masts can be faintly seen. In an instant, the destroyer takes advantage of this fact and sends a torpedo, guided by the masts.

Smoke Screens Turned the Tide of Battle

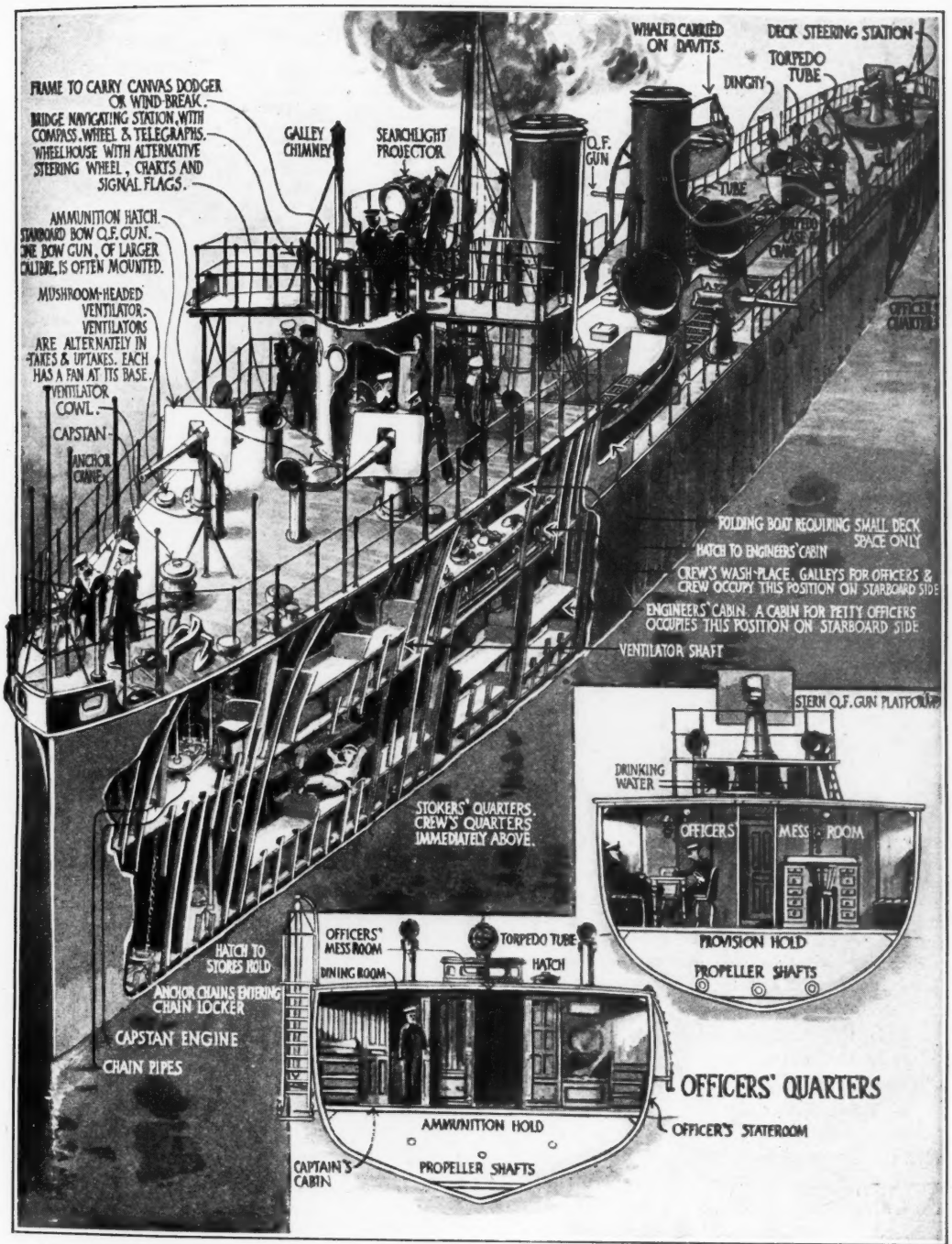
It was this style of tactics of the German destroyers which served the Germans so well in the battle of Jutland. At the time their battleships were being hard hit, the German destroyers formed a veritable wall of smoke and enabled their countrymen to gain a temporary advantage.

The torpedo boat destroyers have still another duty equally as important—that of scouting. Their lightness makes them swift and gives them a very large cruising radius. They can therefore scout far ahead of a squadron and can report their observations of the enemy by wireless. The advancing line of bigger ships by this means is made well aware of what it is up against long before the enemy ranges into sight. Forewarned is forearmed, and the squadron can prepare itself for the impending fight as a consequence.

Methods of the Scout

This competency of the destroyer as a scout will undoubtedly make her of great importance in our coast defense. She is capable of discovering the approach of any hostile fleet days ahead of the time that fleet will near our coast. She would immediately make her wireless report, and would continue to follow at a safe distance from the fleet and report its every movement. The destroyer will continually use her long-distance tactics of firing torpedoes in the general direction of the fleet, and there are two chances out of seven that she will hit the ships of the line. Meanwhile she can give information to our submarines to facilitate their surprise attacks also.

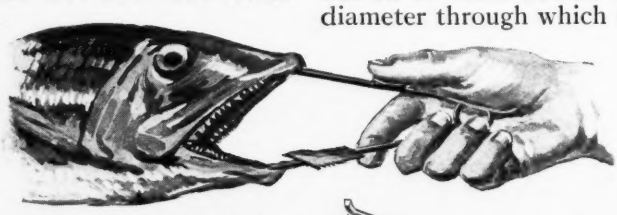
The Vitals of a Torpedo-Boat Destroyer


FRAME TO CARRY CANVAS DODGER OR WIND-BREAK
BRIDGE NAVIGATING STATION, WITH COMPASS, WHEEL & TELEGRAPHS. WHEELHOUSE WITH ALTERNATIVE STEERING WHEEL, CHARTS AND SIGNAL FLAGS.
GALLEY CHIMNEY
SEARCHLIGHT PROJECTOR
WHALER CARRIED ON DAVITS.
DECK STEERING STATION
TORPEDO TUBE
DINGHY
O.F. GUN
TUBE
AMMUNITION HATCH. STARBOARD BOW O.F. GUN. ONE BOW GUN, OF LARGER CALIBRE, IS OFTEN MOUNTED.
MUSHROOM-HEADED VENTILATOR. VENTILATORS ARE ALTERNATELY IN-TAKES & UPTAKES. EACH HAS A FAN AT ITS BASE.
VENTILATOR COWL
CAPSTAN
ANCHOR CRANE
FOLDING BOAT REQUIRING SMALL DECK SPACE ONLY
HATCH TO ENGINEERS' CABIN
CREW'S WASH-PLACE. GALLEYS FOR OFFICERS & CREW OCCUPY THIS POSITION ON STARBOARD SIDE
ENGINEERS' CABIN. A CABIN FOR PETTY OFFICERS OCCUPIES THIS POSITION ON STARBOARD SIDE
VENTILATOR SHAFT
STERN O.F. GUN PLATFORM
DRINKING WATER
OFFICERS' MESS ROOM
PROVISION HOLD
PROPELLER SHAFTS
STOKERS' QUARTERS. CREW'S QUARTERS IMMEDIATELY ABOVE.
OFFICERS' MESS ROOM
TORPEDO TUBE
HATCH
DINING ROOM
HATCH TO STORES HOLD
ANCHOR CHAINS ENTERING CHAIN LOCKER
CAPSTAN ENGINE
CHAIN PIPES
OFFICERS' QUARTERS
AMMUNITION HOLD
OFFICER'S STATEROOM
CAPTAIN'S CABIN
PROPELLER SHAFTS

The torpedo boat destroyer is the swiftest warship. She is designed to sweep upon enemy battleships, and torpedo them before their secondary batteries can effectively strike back. A number of small-caliber guns are mounted on her deck to ward off counter-attacks of submarines and of destroyers like herself. In defending our coasts she is indispensable for scouting for hostile raiders and submarines, and for discovering mines

Tongs for the Fish That Swallows His Hook

THE fish that swallows bait and hook is not a joy to the angler. Getting the hook out is no easy task. But the task is simplified by using the very handy device shown in the illustration. In any case where the hook has not been swallowed further than the gullet the device enables the fisherman to get hold of it.



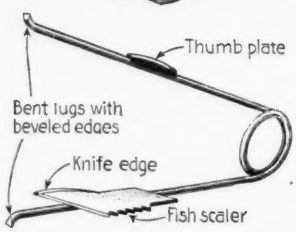
When the tongs are inserted in the fish's mouth they spring back and hold the jaws stretched open

The device is made from one piece of elastic steel wire bent in the shape of a pair of tongs. The ends of the two arms of the tongs are sharpened to a point. When a fish has been caught which has swallowed the hook, the arms of the tongs are compressed and their ends are inserted in the fish's mouth. The arms will then spring apart and hold the jaws open.

The two arms of these tongs are also provided with metal plates. These can be used for obtaining a firm hold upon the tongs. The lower plate, it will be noticed, has a set of teeth sharpened on one side, while a cutting edge is sharpened on the other. Thus, this instrument also furnishes a scraper for scaling the fish, and a knife for cutting it open.

Catching Flies by the Barrelful with a Home-Made Trap

THIS simple but very efficient fly-trap is nothing but a common barrel with a cone of wire screening fastened into one of the ends and extending up into the barrel about half-way. The apex of the cone is cut off so there will be a hole one inch in diameter through which the flies escape up into the barrel.



Three little blocks, which hold the barrel about two inches off the ground, form the entrance to the trap. A pan containing molasses or other bait is set on the ground, and the barrel is placed directly over it. The flies swarm under the barrel and feed, but instead of leaving by the way they entered, their natural instinct will be to fly up into the cone, being attracted by the light streaming down into the barrel through the top, which is covered over with a piece of screening.

Set the trap out of doors and forget it for a few days, at the end of which time you will probably have a catch resembling the one illustrated, and your neighborhood will send you a vote of thanks.

The Acids of Fruit Are the Best Mouth Cleansers

UNLESS the teeth are very badly damaged or eroded, the acids of fruit, such as that contained in grapes, oranges, lemons or apples, will be found to be a satisfactory mouth-wash. The advice of a dentist should be sought, however, to determine the condition of the teeth and to decide whether an alkaline or acid wash is preferable for the individual case. But there is no question as to the efficacy of the food acids in removing quickly and entirely the mucous films that are the first stages of dental decay.

An apple eaten in the evening will cleanse the teeth mechanically and chemically, and if followed by vigorous brushing will protect them from bacteria during the night.

At left of the picture is shown a collection of dead flies caught in the barrel trap shown on the right in forty-eight hours

Making Pearls to Order

A Japanese plan for putting oysters systematically to work

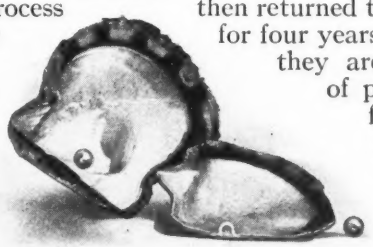
The work on the oyster farm is done almost entirely by women. Here are women divers, with no other equipment than their baskets, bringing up pearl-oysters from the deep-sea beds

ONE of the queerest farms in the world is situated on the Island of Tatokujima, in the Bay of Ago, Japan. The farm lands lie fathoms deep in water, and the crops are lustrous pearls.

Oyster shells are lined with a smooth coating which is commonly called mother-of-pearl, or nacre. The oyster builds up this lining layer on layer.

If any foreign substance—even a grain of sand—happens to enter the shell of an oyster the oyster immediately begins to allay the irritation it causes by surrounding it with the material it uses to build up the lining of its shell. This process the oyster keeps up year after year.

Pearls are not made by oysters alone. Any mollusk may form them, but pearls formed by common oysters and clams are not particularly attractive.



A perfect pearl of the "Oriental" variety. The seed inserted inside the shell was covered over with shell-lining

On the farm at Tatokujima the first steps toward the production of the pearls are taken during July and August of each year. Wherever the larvae of the pearl-oysters have been found most abundant, small pieces of rock and stone are placed. In a little while oyster-spat will be attached to these rocks. Then the rocks are removed to beds which have been prepared for them in deep waters. If they are left in shallow water during the winter the oysters may perish from the cold. They are left in the deep water beds undisturbed for three years. Then they are taken out of the sea, and into each oyster is introduced a small seed-pearl or a small round piece of nacre which serves as the nucleus for a future pearl. The oysters are then returned to the sea where they remain for four years. At the end of that time they are taken out and the harvest of pearls is reaped. During the four years the oyster has been busily engaged in piling layer on layer of nacre around the bit of foreign substance which was so artfully introduced into its shell.

The work of the oyster-farm is done principally by women. The divers remain under water incredible lengths of time.

Protecting Mine Rescue Workers from Gas

A new type of breathing apparatus supplies oxygen in just the right quantities

IN January, 1914, the director of the Bureau of Mines commissioned Mr. William E. Gibbs, a mechanical engineer of New York City, to design a new type of apparatus for use in mine disasters.

The new apparatus has many points of superiority over those which have been used formerly. By means of a special device, oxygen is supplied to the wearer at the rate it is used. While sufficient is available when the wearer is working, none is wasted when he is resting. The harder a man works the more oxygen is necessary for him.

The flow of oxygen may be regulated by means of a valve which is very easy to operate. When this reducing valve is attached to a cylinder of gas, it is possible to admit oxygen to the breathing bag in the exact quantity required by the user.

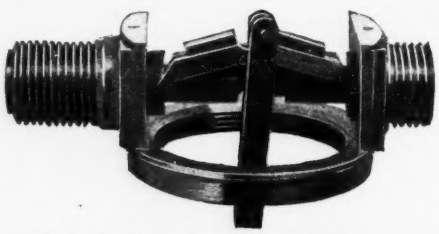
The new breathing apparatus is constructed of metal, with the exception of a rubber gasket. All parts of the apparatus are mounted on a frame of steel tubing which is carried on the back. When in use, the entire apparatus is protected by an aluminum cover. The oxygen is carried in a cylinder or bottle at the bottom of the apparatus. This cylinder has a stop valve connected with the reducing valve, from which the gas passes by way of a tube past the safety valve within the breathing bag. The safety valve has a whistle in its outlet. This whistle gives warning of leakage at the reducing valve. When the wearer breathes, air from the breathing bag lifts the inhalation valve and passes through a flexible tube and mouthpiece to the lungs. The exhaled breath passes to the exhalation valve down a flue to the absorber where it is converted, then up through the cooling can, where it loses its heat, and then into the breathing bag. When the supply of oxygen in the bag gets low, the flap opens the admission valve and a fresh supply enters.

A mine rescue worker wearing the new breathing apparatus. The aluminum cover is broken away to show interior

The absorbing can contains twenty vertically arranged sheets of fine iron-wire gauze, held parallel to each other one-fifth of an inch apart. Before being inclosed in the can this bundle of gauze sheets is dipped into molten caustic soda containing twenty per cent of water. The mixture solidifies on the gauze when cool, forming reinforced plates about one-sixteenth of an inch thick. This makes an absorber of carbon dioxide. The plates maintain a uniform surface from which the condensed and chemically produced moisture constantly drains away, carrying with it the newly formed sodium carbonate. The capacity of this absorber is practically constant, until the active material is all used.

The apparatus is completed by a pressure gage (finimeter) which is read by touch instead of by sight, because, in the darkness of a mine disaster, it would be impracticable to depend on sight. This gage sounds an alarm when the oxygen in the cylinder has been reduced beyond the point of safety.

Instead of a helmet a simple mouthpiece and nose clip are used with the apparatus.



The reducing valve automatically regulates the flow of oxygen from the tank

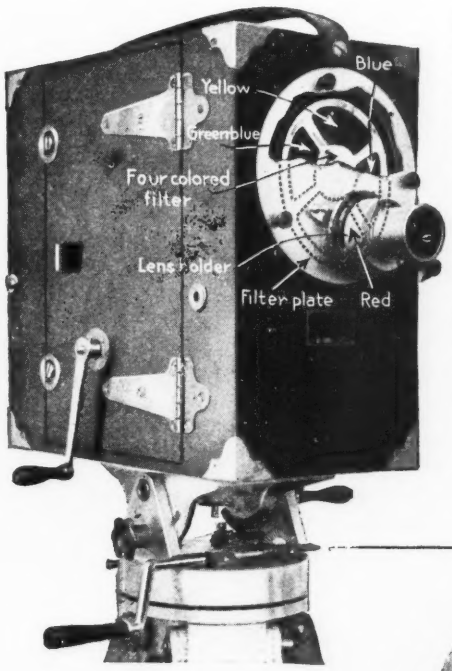
Making Natural-Color Motion Pictures

Light filters through a four-colored attachment which is rotated in front of the projector lenses

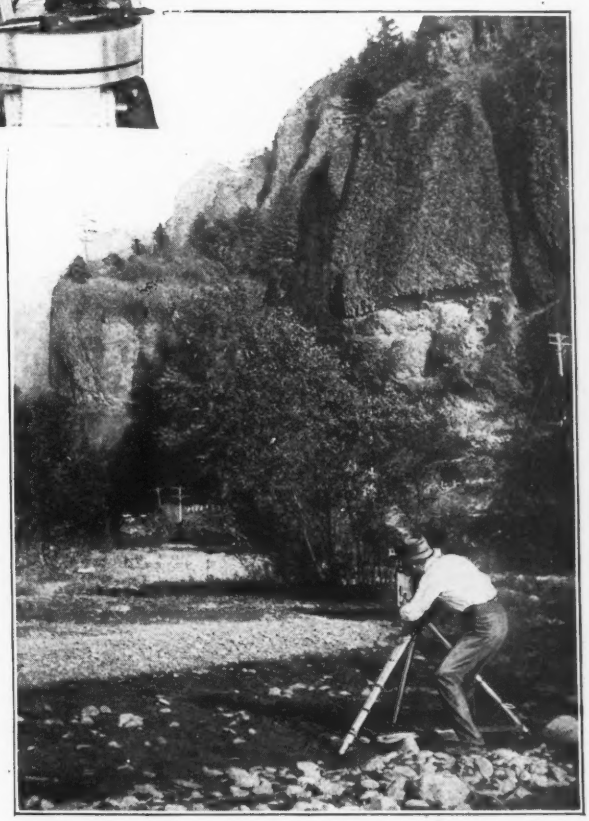
NATURAL-COLOR motion pictures have not been a success in the past. Color results were too poor to warrant the mechanical complications and the consequent expense of the necessary processes. A new system is being commercialized, however, which is unusually simple and which produces pictures more truly colored than ever before.

Like its predecessors, the new system depends upon the fact that beams of certain primary colors when mixed together in varying proportions of intensity will produce a ray of light which will show forth every color in the spectrum. In the new process, the pictures are taken by the camera through a four-colored rotating filter, so that one primary color will affect one picture of the film, a different primary color will affect the next picture on the film, and so on in very rapid succession. The developed film is run in the projector with a corresponding colored filter, and the color pictures are thrown on the screen in the same rapid sequence as they were taken in the camera. Twenty-four color pictures follow each other in a second. The eye has not the time to distinguish one color from the other. They blend all together and produce almost the same effects of color which appeared in the original scene.

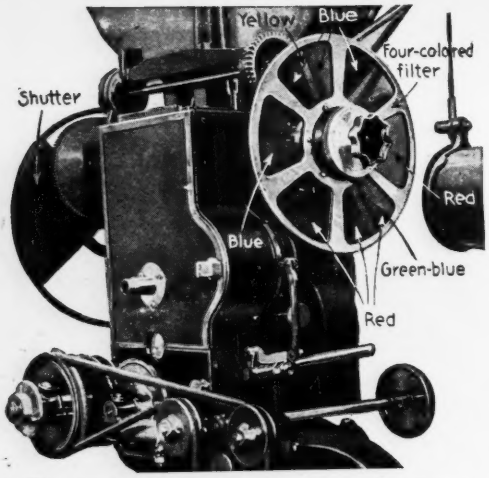
This process is therefore similar to that of the ordinary motion picture, with the colored filter thrown in. It is no more complicated. Even the film looks black and white like the others; only of course, each film picture instead of containing the complete outline as in ordinary motion pictures, contains only the part of the complete outline which corresponds to one of the four primary colors. The colors which have been found to produce best effects are red and green-blue, yellow and blue. Blends of these produce colors so realistic that the separate figures on the screen seem actually to stand out in relief. A system as simple and effective as this brings us much



At left: The four-colored rotating filter through which pictures in four different colors are taken in rapid succession



Photographing natural scenery in all the beauty of its own coloring, by means of the filter camera attachment which "tones in" the primary colors



The mechanism of the attachment by means of which the colors are blended on the screen

nearer the day when natural color motion pictures will be the only ones in use.

Experiments are now under way for perfecting a process of dyeing the black and white film the color of the four primary hues. If this can be done—and recent tests seem to promise that it can—there will be no need of the four-colored filter on the projector, and this natural color system will be simplified so much further.

It is planned to take the black and white film which has been exposed in the camera and simply immerse it in vats containing the various dyes. When it is placed in the red vat, for instance, all of the individual pictures of the film, excepting the one-fourth of them which correspond to the red portions of the scene, are covered up by small rubber blocks. The dye cannot touch them, therefore, while those parts of the pictures which correspond to the red portions of the scene are colored red.

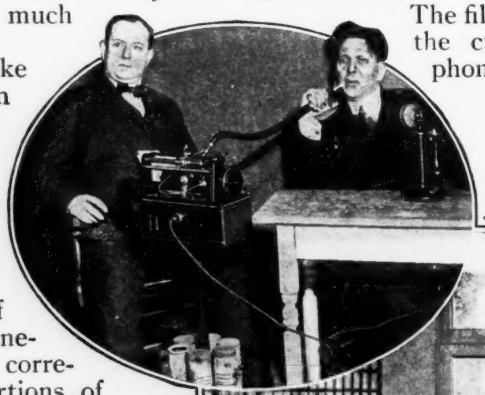
After these pictures have dried, they are covered up and the rubber blocks are removed from those portions of the picture to be dyed blue in a similar way. And this is done for the yellow and the green-blue portions also. The film is thus colored directly and no extra filter is needed on the projector.

"Editing" a Motion-Picture Film with a Phonograph

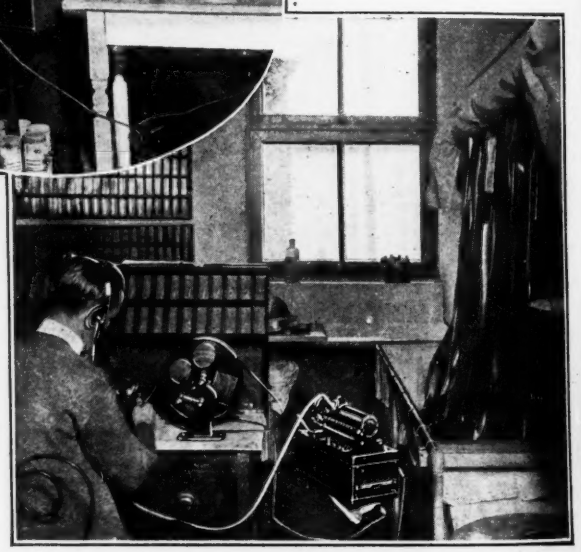
AFTER a motion-picture film has been developed and printed it is sent to the general manager or to the director to be "edited." Like an author's manuscript in the hands of an editor, it is shortened here and there, the captions altered, some parts entirely "cut" or deleted, and the whole film dressed up to suit the ideas of the men closest in touch with the theater-going public.

The editing takes place in the projection room, but the altering—cutting the film and changing it—is done in the cutting and assembling room by men who do nothing else. Sometimes the men in the cutting room ("cutters," in the trade lingo) are so overwhelmed and confused with orders issued by the studio officials that they are compelled to ask for additional explanations. Needless to say this wastes much time.

By means of the phonograph, however, one motion-picture company is eliminating this waste and saving money. As the director watches a picture in the projection room he utters his editing orders into the transmitter of a dictating machine. The film is then sent back to the cutting room with the phonograph record.



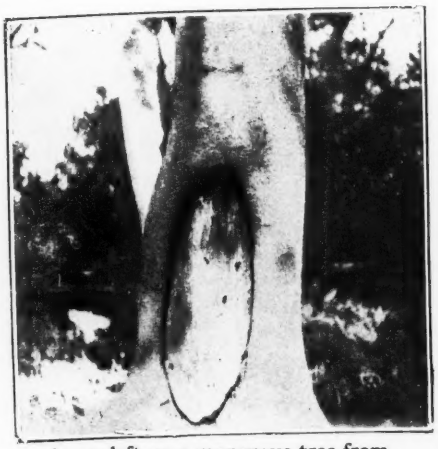
As the director watches a picture he utters his editing corrections into the transmitter of a dictating machine



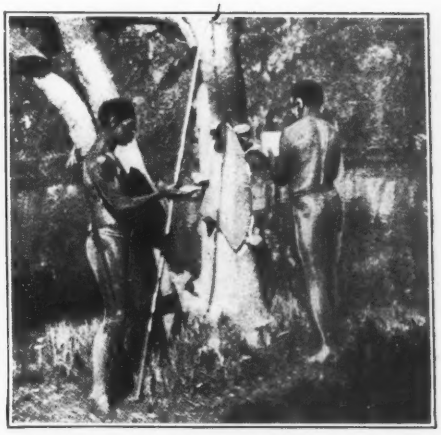
In the cutting and assembling room the corrections are made from the records of the dictating machine

The Mangrove Shields of the Savages

The implements were crude but the product was serviceable and artistic



A scar left on a mangrove tree from the tearing away of bark for a shield



Driving the stone edges in around the oval piece of bark marked off

The perfect shield, trimmed, polished and provided with a handle made of twisted vine tendrils

IN the days when the savages of the New South Wales coast fought with spears and boomerangs, a stout shield was an important part of the warrior's equipment. White men, with their firearms and their tools of steel, had not yet arrived. The Stone Age had not given place to the Age of Iron.

Nobody knows when the first enterprising native discovered that the gray mangrove tree could be made to yield a shield of unrivaled toughness by a comparatively simple operation. This consisted of cutting through the bark of the trunk an oval groove, or rabbet, two or three inches deep. Into this groove were inserted a number of wedges made from a special kind of stone. By driving these wedges in with a stone hammer, a layer of wood was brought away in a single piece; then a little trimming and the attachment of a bit of twisted vine sufficed to convert the piece into a perfect shield.

In the Port Macquarie district almost every gray mangrove tree of suitable size has been made to yield such a shield, and in many cases two or more shields have been taken from one trunk. The conspicuous scars remain to tell the story of a vanished art. Some of these scars are believed to be more than five hundred years old, while some are relatively modern, and were made with steel axes.

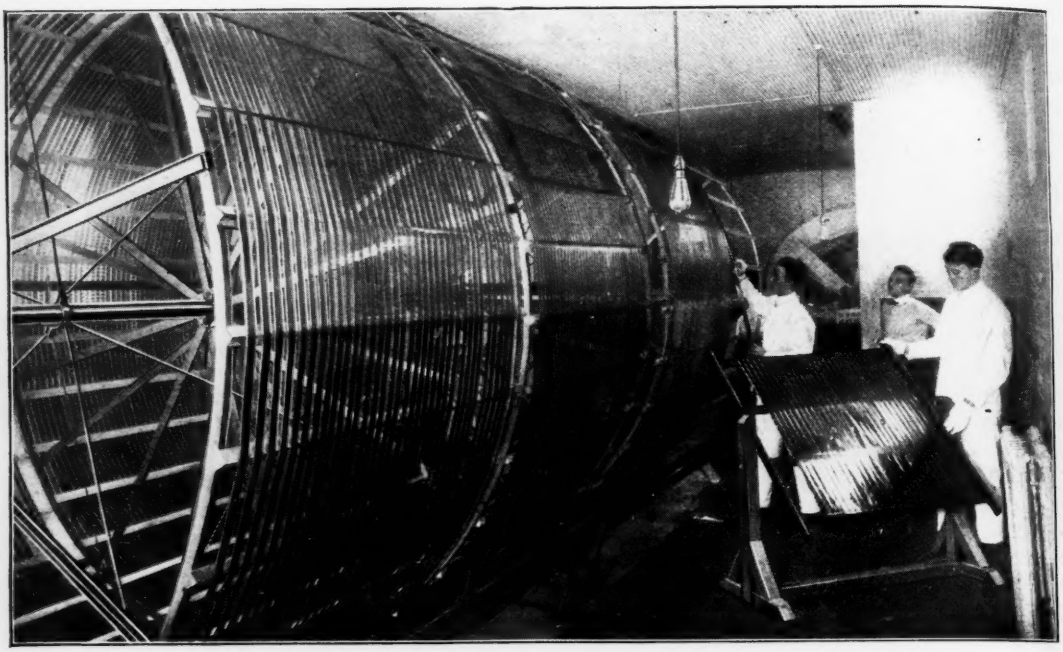
The earliest English shields were "bucklers" of lindenwood and were made in much the same manner as these mangrove shields of the savages, except that they were provided with strong iron ribs and bosses.

Throwing Heat Overboard from Ocean Steamers

ON all sea-going steamers, the steam is condensed by sea-water pumped through the surface condensers. This circulating water is then discharged overboard. In the process of condensation, the cooling water taken in at temperatures varying from 32 degrees to 88 degrees Fahrenheit according to climatic and other conditions, is raised to temperatures varying from 80 to 120 degrees and then discharged. This great loss of heat is practically unavoidable. Even on comparatively small steamers, hundreds of tons of heated water are pumped overboard daily. This constitutes one of the greatest heat losses in the operation of steam machinery, although sometimes a portion of the warm water is used for scrubbing decks and for bath water on passenger ships.

How Motion Picture Films Are Made

By R. W. Baremore

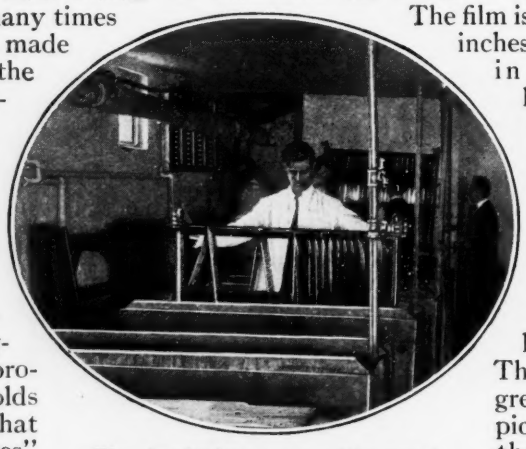


On these big drums the films are dried after developing. They revolve slowly, throwing off the water and exposing the emulsion side to a constant current of hot air

THE system of taking a motion picture and the developing and printing of the film, follow closely the methods employed by the amateur photographer, even though the film is handled in very much greater lengths. It is run through the motion picture camera in much the same manner as in the lowest priced kodak; it is developed in a tank similar to the amateur's, although many times larger, and prints are made from the negative in the well-known way, except that the positive is printed on a celluloid film instead of on sensitized paper.

As a general rule motion pictures are made in thousand-foot lengths. The regulation camera and projection machine holds this length of film. What are known as "features" are produced in multiple reels. Hence the familiar sign "Mary Pickford in Three Reels." This, we know, does not mean that Little Mary has been cut to pieces but that it was necessary to utilize three thousand feet of film to produce the picture.

Motion picture film is much more durable than that which is used in the kodak, and the emulsion is considerably faster. The film is one and three-eighths inches in width and is made in two-hundred-foot lengths, the full reel or one thousand feet being secured by cementing five of these lengths together. On both outer edges of the film are perforations averaging sixty-four holes to the foot. These must be made with great care so that the picture synchronizes with the projector shutter. When the cameraman



The developing room. The workman is agitating the films in a bath

cranks his machine the film is fed through in a series of rapid jerks, the shutter action being almost continuous. Sixteen pictures are made on each foot of film.

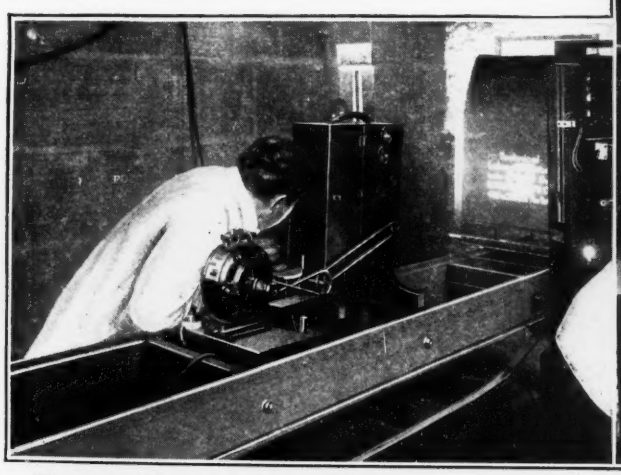
The cameraman, having completed his work, the film is delivered to the developing department. Generally a small piece is clipped and developed to determine light and exposure conditions so that the entire film may be treated accordingly and not spoiled.

Cementing together the 200-foot lengths of film to make a picture of the standard 1000-foot length

The developing is done in large tanks. The film is wrapped around large light frames for convenience. Thus mounted it is easily dipped into the bath, and examined without the direct contact of fingers. When the negative has been developed it is placed in the fixing bath. After that it is thoroughly washed in clean water. The developing and fixing are generally done in two-hundred-foot lengths. It is difficult to handle any greater length.

Large drums made of light metal and wood are used for drying the film. These drums revolve slowly, thus throwing off water adhering to the back of the film and exposing the emulsion side to a constant current of hot air. The drying room must be clean; for even the smallest particle of dust on the film will be magnified many times when the picture is screened. For this reason many special devices have been installed in modern drying rooms to keep them absolutely free from dust and dirt.

In printing the positive from the negative the services of real experts are required; uneven work will produce a bad "flicker" on the screen. Printing has been so highly developed that the old annoying "flicker" has almost disappeared. As in making ordinary pictures the emulsion side of the negative is brought into contact with the positive film and is exposed to the light. Artificial light is used because it is more easily controlled than sunlight. The printing machines used work on the same principle as the motion picture camera with the exception that they "take" two rolls of film, both the positive and the negative. In developing the positive



Photographing the titles and subtitles on films from block-letter signs, with a regular motion-picture camera

Printing the positive from the negative. The printing is done by artificial light

Washing the negatives in clear water after the developing and fixing process. Two-hundred-foot lengths are handled at one time and afterward pieced together

film an additional bath is required to clear the high lights and sharpen the detail; otherwise the method is the same as for the negative.

The two-hundred-foot lengths of film are then wound on reels, five lengths being cemented together to produce the standard length of one thousand feet.

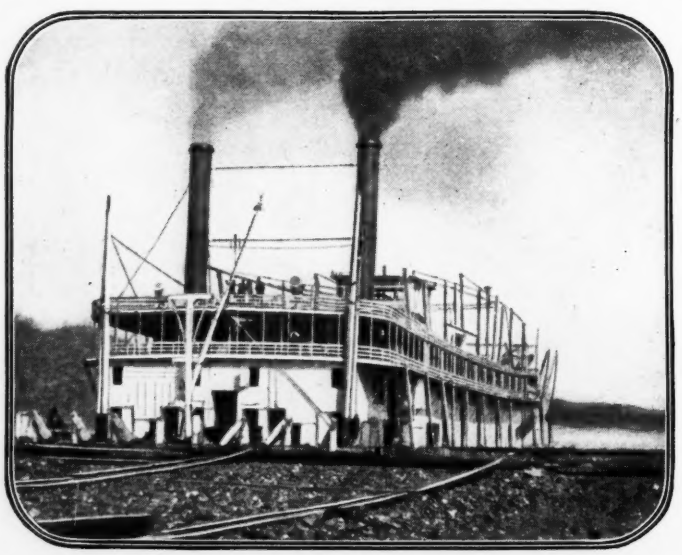
In every picture "titles" and "subtitles" are required to explain the action. These are photographed on the film when the other parts of the picture have been taken. The piecing together of the various sections of film requires the exercise of great care for never are the scenes of a play filmed from beginning to end exactly as they are planned by the scenario writer. If five different episodes take place in a drawing room, they will all be photographed at once, even though hundreds of feet of landscape film may ultimately intervene between them.

Six Acres of Coal Floating on the Mississippi

ONLY in the United States can such a sight be seen as six acres of coal floating down a river as a single unit. This is the area of coal boats which the well-known stern-wheel steamer *Sprague* is capable of handling as a single tow. Four across-stream rows of twelve boats each, make up the principal part. Back of the fourth row, however, eight boats find places together with two barges. Hence, there are fifty-six boats and two barges in the big fleet. The *Sprague* has her nose shoved in at the center of the fifth row. The fifty-nine vessels are lashed securely together by lines which run from boat to boat. Although the *Sprague* can push the fleet ahead, her chief duty is to hold back the load.

This great amount of coal is handled by a relatively small total of horsepower because the current of the onflowing river supplies a large part of the requisite energy.

The big efficient stern wheel of the *Sprague* stands forty feet high. When bends in the river have to be rounded, it controls the boats by suitable backing movements. If the steamer itself goes aground, this big stern wheel may be utilized to drive water in under the stern of the boat to supply a kind of miniature flood tide. When the sand bars, swift current and tortuous course down the Mississippi River, where the *Sprague* is principally engaged, are taken into consideration, it will be granted perhaps that the captain has a responsible, difficult task.



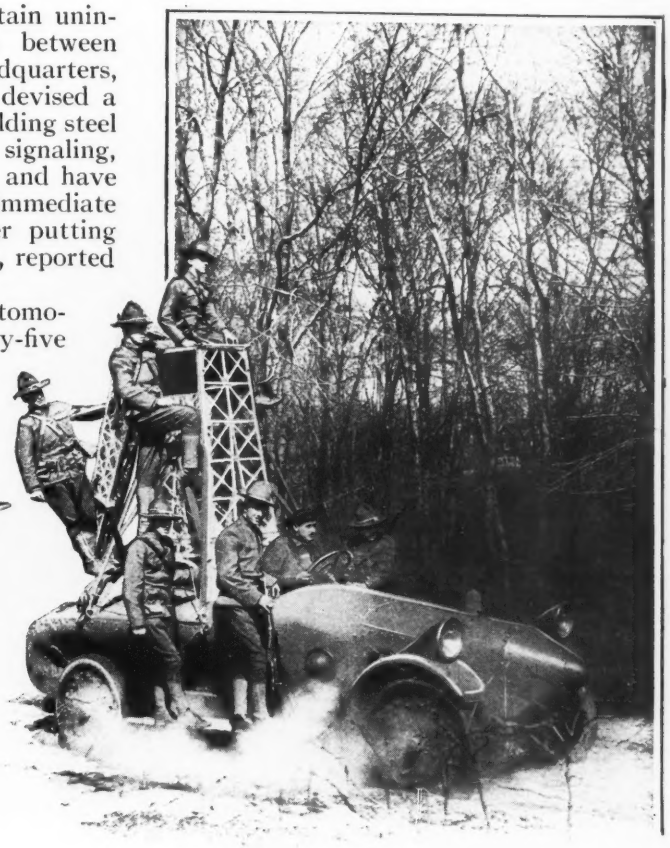
A typical coal boat. It is twenty-six feet wide and travels abreast of eleven others and a steamer

An Observation-Tower Car for the Army

It would serve as an outpost station for wireless apparatus, signaling and sharp shooting

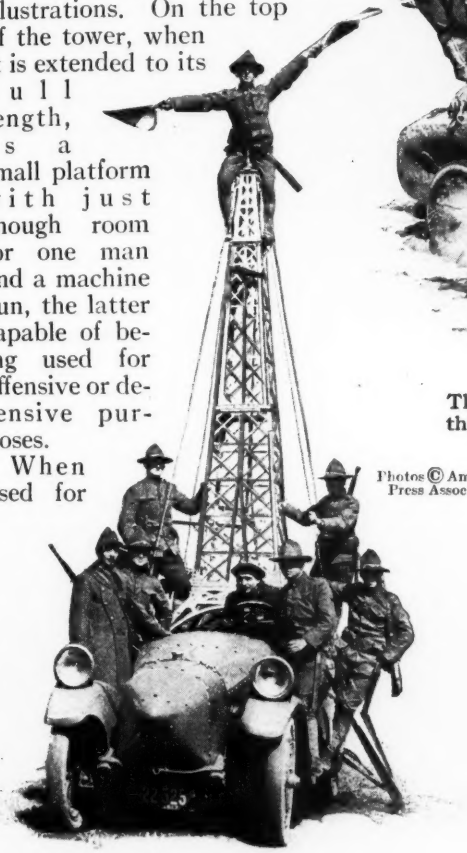
TO enable an army to maintain uninterrupted communication between scattered forces and headquarters, two New York City men have devised a new form of armored car, with folding steel tower for wireless apparatus, signaling, observation and sharp shooting, and have offered it to the Government for immediate use. National Guardsmen, after putting the car to a severe test recently, reported favorably upon it.

The tower of the armored automobile is of steel and extends twenty-five feet in the air. When the machine is in motion and the tower is not used for observation purposes, it may be folded back as shown in one of the illustrations. On the top of the tower, when it is extended to its full length, is a small platform with just enough room for one man and a machine gun, the latter capable of being used for offensive or defensive purposes.



The armored tower car traveling at high speed with the top portion of the steel tower folded back

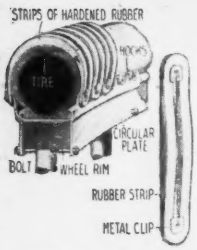
When used for signaling and observation work the car may take up a certain position and be considered as an outpost station, or it may move about from one section of the country to the other, keeping in communication with the general staff by means of its wireless apparatus. Furthermore, it may be used with equal facility at night, signaling being carried on with the aid of searchlights or by wig-wagging with lights instead of the usual flags. With the car traveling at high speed a man can take up his position at the top of the tower and wig-wag information to other moving observation towers, or obtain military knowledge while moving through the enemy's country at great speed in the event of the failure of the ordinary means of communication.



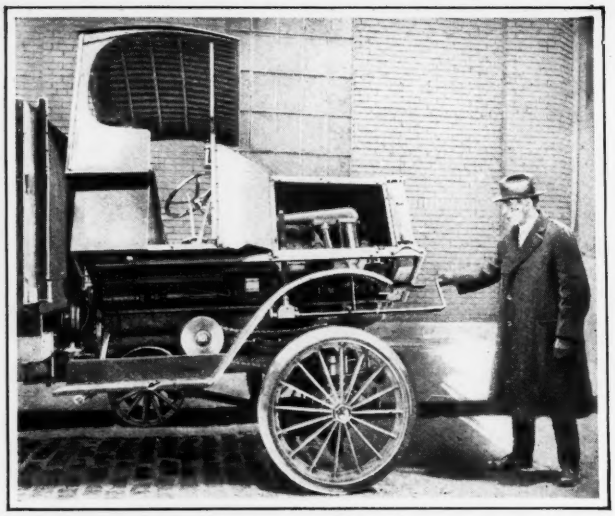
Photos © Amer. Press Assoc.

National Guardsmen using the car as a signaling station. At night colored lights would be used instead of the flags

The Latest Additions to the Constantly-Increasing

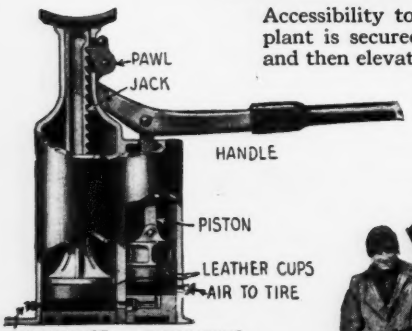


Thick strips of hardened rubber placed across the face of a tire prevent skidding and protect the tires from punctures

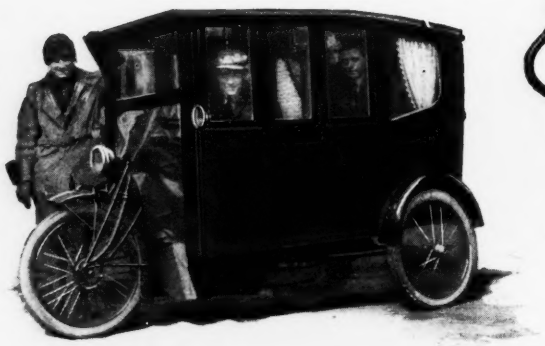


Accessibility to every part of the motor-truck power-plant is secured by hinging the crankcase on one side and then elevating it with a small screw-jack, as shown

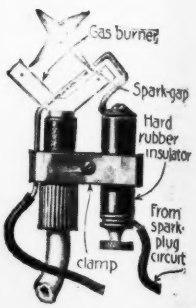
A protective pad for several styles of heels, which saves the shoe when the driver is operating the clutch or brake lever of the car



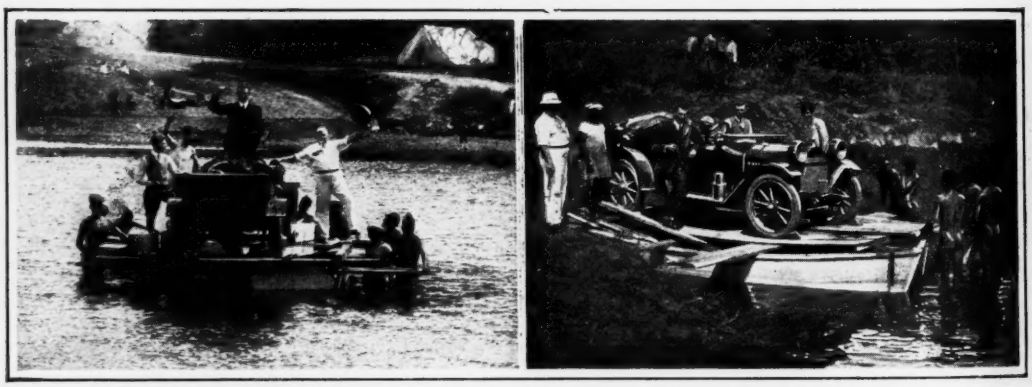
A combined automobile pump and jack. A single handle operates the device for either purpose. It is carried with the tools



A motorcycle limousine with seating capacity for three passengers. It is a three-wheeled affair

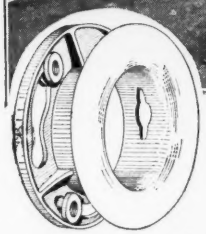


A lighter for gas headlights on automobiles. Wires from the spark-plug circuit connect with each burner

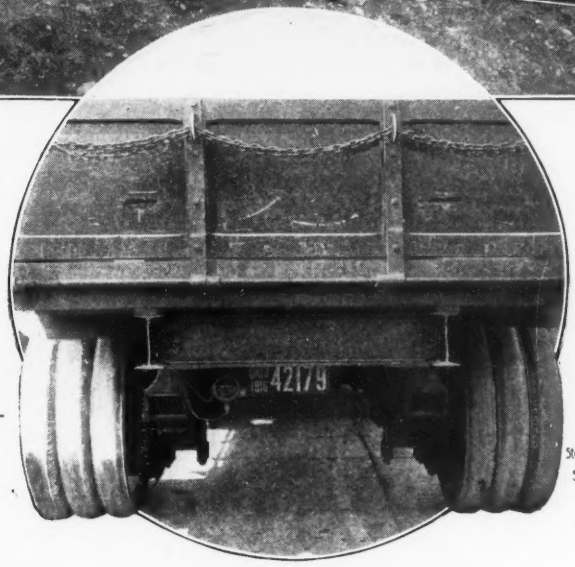


How an American automobile party crossed an African river. A flooring of planks was placed on an ordinary flat-bottom row-boat and the automobile was balanced on it. The craft was then pushed across by natives and the landing was made at the other side by utilizing heavy beams

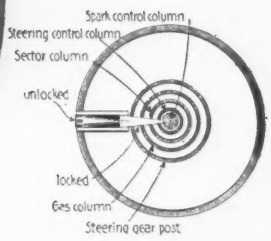
Variety of Automobile Accessories and Conveniences

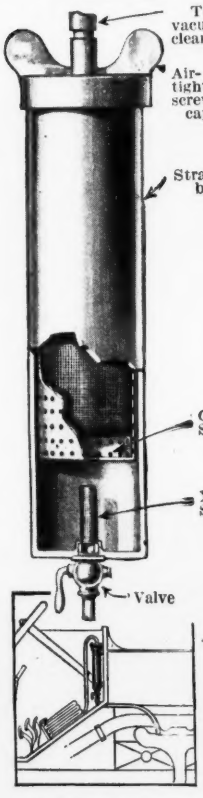


Capstan hub caps make it easy to extricate a mired car. A rope is attached to each of the rear wheel capstans and the free ends to a stake or a tree

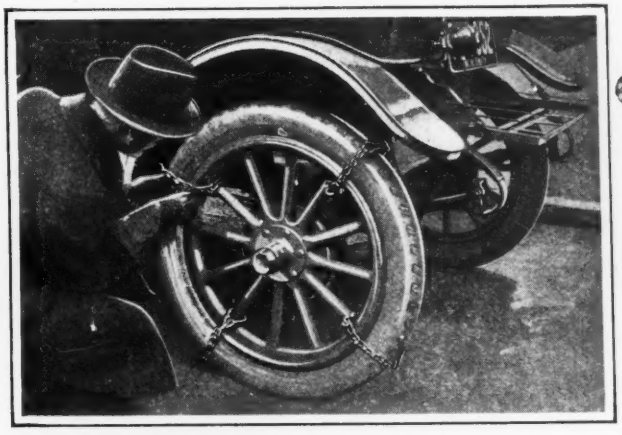


A triple tire wheel as standard equipment for trucks of large capacity. It gives a considerably greater mileage than the dual tire wheel

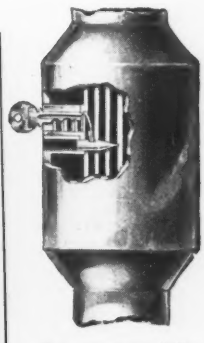




A vacuum cleaner for the automobile. The pumping action of the engine is utilized to create the vacuum. The device can be applied to any engine



Single chains attached to the spokes have leather-covered fasteners which do not injure the rim. They cannot strike the mudguard and can be fitted on solid as well as on the pneumatic tires



An automobile lock which secures the steering mechanism, gas, and spark control against operation. It is attached to the steering post below the wheel

The World's Most Powerful Searchlight

It sends forth a beam as brilliant as fiercest sunlight

IT is ten feet high, its mirror has a diameter of five feet, and it weighs three tons. Its beam is as brilliant as the sun at eight o'clock in the morning or four in the afternoon, New York latitude, and you can read a newspaper by its light thirty miles away. The heat of its focused beam is so intense that it will set paper afire at a distance of two hundred and fifty feet. It has a candlepower of more than one and a quarter billion.

These are a few astonishing facts about the Sperry searchlight, the invention of Elmer A. Sperry, of Brooklyn, N.Y., who is already known as the inventor of the airplane stabilizer and ship gyroscope bearing his name and the first electric arc light. When the last big air raid over London was made by Zeppelins, the Sperry searchlights bathed the big dirigibles in beams of light they could not escape. According to some London accounts the Sperry searchlight is the Zeppelin's Nemesis.

Elmer A. Sperry, inventor of the greatest searchlight

One of the most powerful beacons along the coast is the Sandy Hook Lighthouse. But the Sperry searchlight is twenty-two times more brilliant than that light. Were the Sperry lamp substituted for the lighthouse beacon, a ship passing out to sea could be bathed in light until it disappeared below the horizon. By swinging the light back and forth across the sky it has been made visible one hundred and fifty miles away. For Navy use the Sperry lamp illuminates a target ten times more brilliantly than any other projector devised.

Equipped with a carriage that permits the lamp to be turned in a circle and in any direction up to ninety degrees, the giant searchlight is of the greatest value in detecting aircraft. The operator can not control it near at hand; the great heat prevents that. He must stand fifty feet away. At that distance he is able to focus accurately upon any moving object. Because the rays projected by the lamp are nearly parallel, there is no diffusion of light over a wide area. The beam is concentrated.

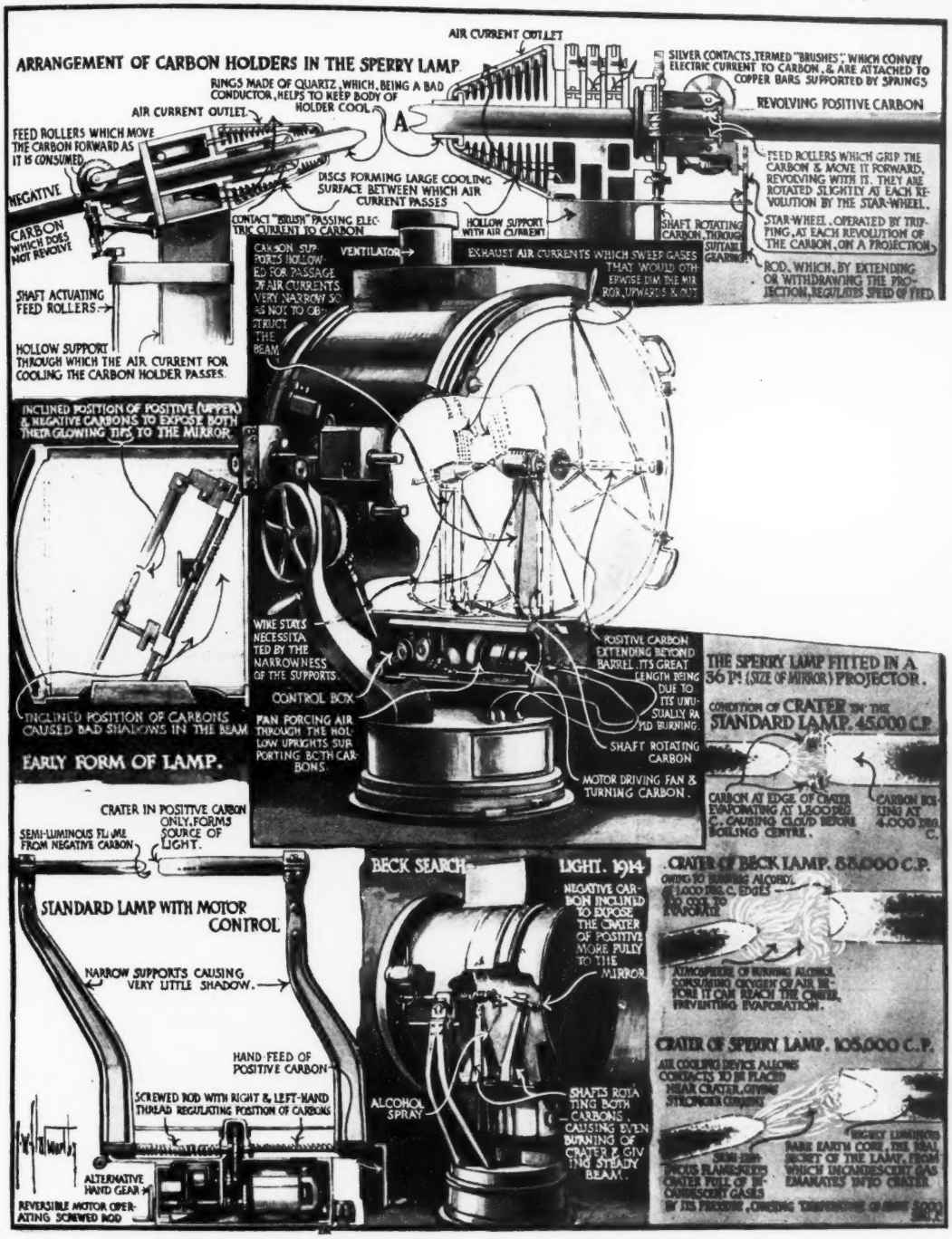
When the searchlight is being operated, the temperature of the arc is nine thousand degrees Fahrenheit—seven thousand degrees higher than the melting point of the metal holders of the carbons. Consequently, in order to prevent these parts from melting, a current of air is forced, by means of a motor-driven blower, through the carbon supports and discharged through the heat-radiating disks that surround the holders. In the Beck lamp the holders are sprayed with alcohol to prevent them from melting.

The several factors which combine to make the Sperry lamp so powerful are the small electrodes, the special carbons used, the manner in which they burn and the parabolic mirror. A colored glass peep-sight enables the operator to watch the arc without being blinded by the glare, or the arc is reproduced by lenses upon a ground glass outside the lamp. An iris diaphragm similar to that used on cameras, regulates the light.

Stand in the beam of the Sperry lamp at any distance closer than three hundred feet and your skin will be burned. At that distance the skin peels. The great heat of the arc is due to the fact that it produces a crater which more nearly approximates the mathematical point of light than does that in other searchlights. The candlepower is more than three hundred and twenty thousand per square inch.

Designed for naval and military purposes, the Sperry lamp, in addition to locating enemy forces on land and in the air, is useful also in throwing a screen of powerful light in front of the enemy. It is impossible to see through its concentrated beam. Allied field forces have mounted the lamp on armored cars and have found it available for signaling at any distance up to one hundred miles.

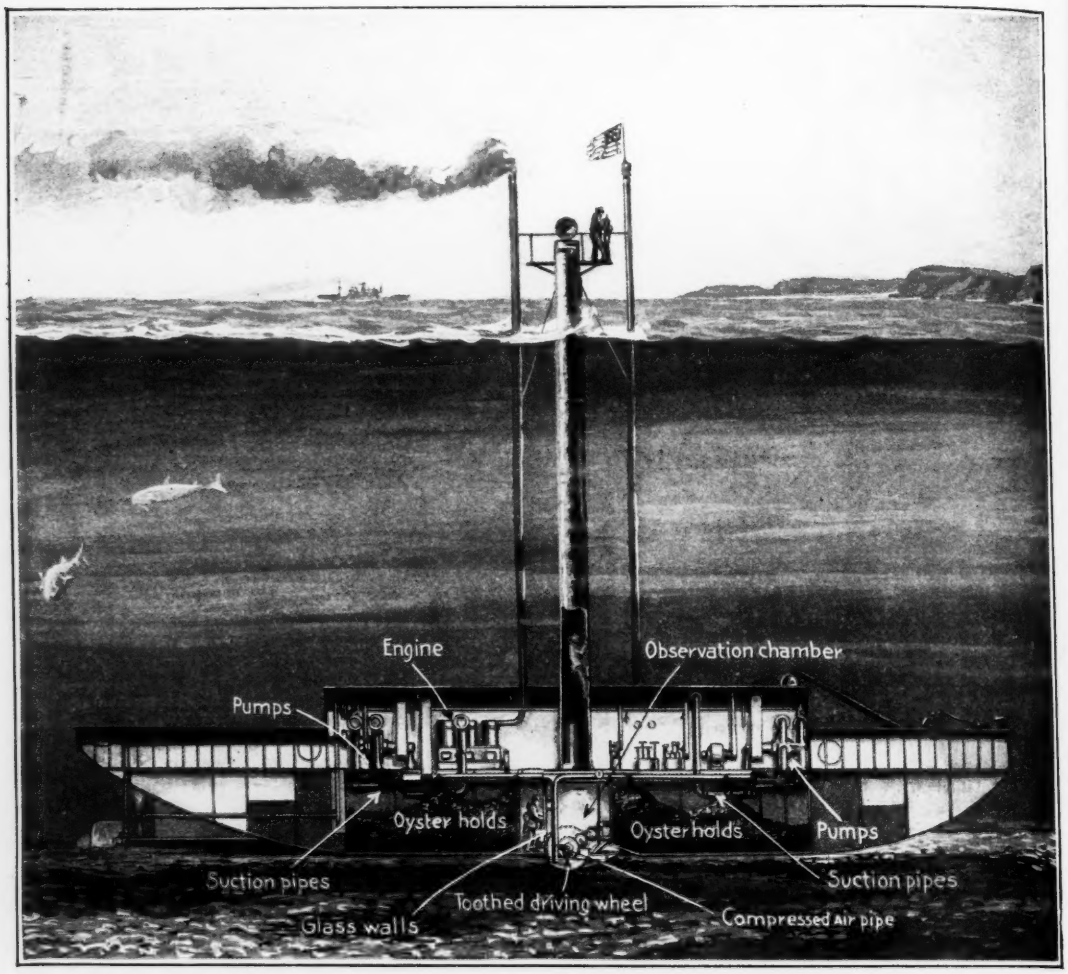
It Will Burn Your Skin at Three Hundred Feet


ARRANGEMENT OF CARBON HOLDERS IN THE SPERRY LAMP
AIR CURRENT OUTLET
RINGS MADE OF QUARTZ, WHICH, BEING A BAD CONDUCTOR, HELPS TO KEEP BODY OF HOLDER COOL
AIR CURRENT OUTLET
A
SILVER CONTACTS, TERMED "BRUSHES", WHICH CONVEY ELECTRIC CURRENT TO CARBON, & ARE ATTACHED TO COPPER BARS SUPPORTED BY SPRINGS
REVOLVING POSITIVE CARBON
FEED ROLLERS WHICH MOVE THE CARBON FORWARD AS IT IS CONSUMED
NEGATIVE
DISCS FORMING LARGE COOLING SURFACE BETWEEN WHICH AIR CURRENT PASSES
FEED ROLLERS WHICH GRIP THE CARBON & MOVE IT FORWARD, REVOLVING WITH IT. THEY ARE ROTATED SLIGHTLY AT EACH REVOLUTION BY THE STAR-WHEEL.
CONTACT "BRUSH" PASSING ELECTRIC CURRENT TO CARBON
HOLLOW SUPPORT WITH AIR CURRENT
SHAFT ROTATING CARBON, THROUGH SUITABLE GEARING
STAR-WHEEL, OPERATED BY TRIPPING, AT EACH REVOLUTION OF THE CARBON, ON A PROJECTION
CARBON WHICH DOES NOT REVOLVE
CARBON SUPPORTS HOLLOWED FOR PASSAGE OF AIR CURRENTS, VERY NARROW SO AS NOT TO OBSTRUCT THE BEAM.
VENTILATOR
EXHAUST AIR CURRENTS WHICH SWEEP GASES THAT WOULD OTHERWISE DIM THE MIRROR, UPWARDS & OUT
ROD, WHICH, BY EXTENDING OR WITHDRAWING THE PROJECTION, REGULATES SPEED OF FEED
SHAFT ACTUATING FEED ROLLERS
HOLLOW SUPPORT THROUGH WHICH THE AIR CURRENT FOR COOLING THE CARBON HOLDER PASSES.
INCLINED POSITION OF POSITIVE (UPPER) & NEGATIVE CARBONS, TO EXPOSE BOTH THEIR GLOWING TIPS TO THE MIRROR.
INCLINED POSITION OF CARBONS CAUSED BAD SHADOWS IN THE BEAM
EARLY FORM OF LAMP.
WIRE STAYS NECESSITATED BY THE NARROWNESS OF THE SUPPORTS.
CONTROL BOX
FAN FORCING AIR THROUGH THE HOLLOW UPRIGHTS SUPPORTING BOTH CARBONS.
POSITIVE CARBON EXTENDING BEYOND BARREL, ITS GREAT LENGTH BEING DUE TO ITS UNUSUALLY RAPID BURNING.
SHAFT ROTATING CARBON
MOTOR DRIVING FAN & TURNING CARBON.
THE SPERRY LAMP FITTED IN A 36 P.I. (SIZE OF MIRROR) PROJECTOR.
CONDITION OF CRATER IN THE STANDARD LAMP. 45,000 C.P.
CARBON AT EDGE OF CRATER EVAPORATING AT 3,800 DEG. C., CAUSING CLOUD BEYOND BOILING CENTRE.
CARBON BOILING AT 4,000 DEG. C.
CRATER IN POSITIVE CARBON ONLY, FORMS SOURCE OF LIGHT.
SEMI-LUMINOUS FLAME FROM NEGATIVE CARBON
STANDARD LAMP WITH MOTOR CONTROL
NARROW SUPPORTS CAUSING VERY LITTLE SHADOW.
HAND-FEED OF POSITIVE CARBON
SCREWED ROD WITH RIGHT & LEFT-HAND THREAD REGULATING POSITION OF CARBONS
ALTERNATIVE HAND GEAR
REVERSIBLE MOTOR OPERATING SCREWED ROD
BECK SEARCHLIGHT. 1914
NEGATIVE CARBON INCLINED TO EXPOSE THE CRATER OF POSITIVE MORE FULLY TO THE MIRROR
ALCOHOL SPRAY
SHAFTS ROTATING BOTH CARBONS, CAUSING EVEN BURNING OF CRATER & GIVING STEADY BEAM.
CRATER OF BECK LAMP. 85,000 C.P.
OWING TO BURNING ALCOHOL 1,000 DEG. C. EDGES TOO COOL TO EVAPORATE
ATMOSPHERE OF BURNING ALCOHOL CONSUMING OXYGEN OF AIR BEFORE IT CAN REACH THE CRATER, PREVENTING EVAPORATION.
CRATER OF SPERRY LAMP. 105,000 C.P.
AIR COOLING DEVICE ALLOWS CONTACTS TO BE PLACED NEAR CRATER, GIVING STRONGER CURRENTS
HIGHLY LUMINOUS RARE EARTH CORE, THE REAL SECRET OF THE LAMP, FROM WHICH INCANDESCENT GAS EMANATES INTO CRATER
THIN NON-LUMINOUS FLAME-SKIN CRATER FULL OF INCANDESCENT GASES

The new Sperry searchlight lamp and its predecessors. The trend in lamp design has been to provide a more intensely luminous source than that of pure carbon. Until recently this was thought impossible, because carbon possesses the highest melting point of any known element. But the newer lights, such as the Beck lamp shown above, and the Sperry lamp, have kept their carbons and metal parts from melting by ingenious means. In the Beck lamp an alcohol spray is used; in the Sperry lamp constant currents of cool air are forced through the carbon supports

Gathering Oysters by Submarine

A peaceful occupation at which the submarine is so efficient that it promises to revolutionize the entire shellfish industry



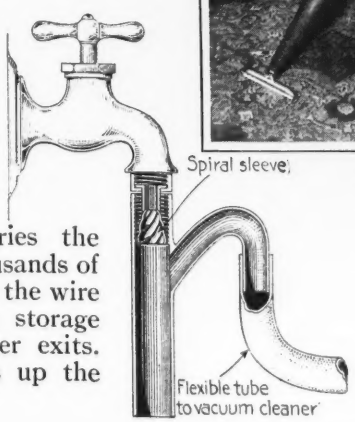
When traversing a good bed the submarine will suck up five thousand bushels of oysters in an hour, leaving the bed clean-swept. It is not diverted from its course by wind or tide

THE submarine is primarily a destroyer. For the most part its inventors thought only of blowing up ships, notwithstanding the dramatically successful trip of the *Deutschland*. Probably the only inventor who believed in its peaceful, industrial possibilities from the very beginning was Simon Lake. He has suggested the use of the submarine for polar exploration, for ferrying supplies across ice-bound rivers, for seeking sunken treasure, and for digging oysters. We have already pictured his transatlantic submarine freight carrier—an older invention than the *Deutschland*—and on this page we illustrate his submarine oyster gatherer.

Preliminary experiments have demonstrated to Mr. Lake's satisfaction that when the submarine is at the bottom of the ocean, the oysters can be sucked up into it on the vacuum cleaner principle. When traversing good ground, the submarine will suck up five thousand bushels of oysters in an hour. This means that in one hour a mass of oysters will be collected which, if compactly piled in a cylinder one foot in diameter, would require a cylinder one and three-quarters mile long to hold it.

The submarine which will accomplish this employs essentially the usual propelling and diving apparatus found in submarines. Its hull is different, however. Nearly the entire bottom-half of the central portion of the boat is given over to the two storage holds. These holds are watertight, but their bottoms can be opened to the sea. A central observation chamber between the holds also opens to the sea. A large-toothed driving-wheel is mounted at the bottom of this chamber, to help drive it along the ocean bottom. Compressed air is turned into the observation chamber to push the water out, and powerful electric lights are then turned on. The operator stationed outside of the glass walls of this chamber can plainly see the bottom.

When an oyster bed is reached, the storage holds are quickly opened. Sea water rushes in. Large centrifugal pumps are started. They force great streams of the water out so that equal streams of water can be sucked in. The inrushing water carries the oysters along with it. Thousands of the oysters will pile against the wire screening which lines the storage holds in front of the water exits. The submarine thus cleans up the oyster bed



The spiral spray creates the vacuum which sucks up the dust

Attach This Hose to Your Hydrant to Run Your Vacuum Cleaner

A VACUUM cleaner has been invented by Beecher W. Junk of Toledo, Ohio, which can be operated wherever there is a hydrant in your house.

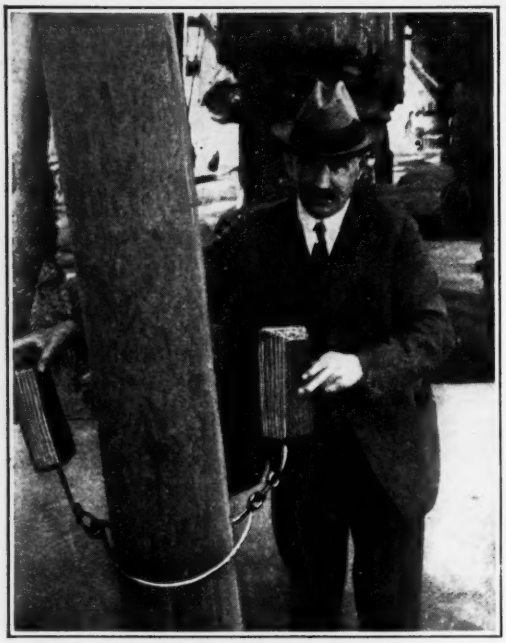
A pipe of the right diameter is screwed into the hydrant's mouth and runs down to the bottom of the sink. A spiral nozzle fits the pipe just below the mouth of the hydrant. An angular pipe opens into the vertical pipe immediately below the nozzle and slopes up to connect with a rubber hose on the guiding rod.

To clean the room, you turn on the water and guide the rod over the carpet. After traversing the spiral nozzle, the water whirls around and passes the opening of the angular pipe, forcing out all the air near it. The vacuum so created starts the air flowing in the rubber hose.

A Flashlight Advertisement on the Cashier's Register

A FLASHLIGHT change holder makes an attractive and useful decoration for showcases or for use in connection with the cashier's register. When the change is deposited in the holder by the cashier, the coin forms a contact, causing a sign to flash into view. The advertisement may be a colored photograph, a drawing, a slogan, or any other thing desired. It comes to the buyer's attention in such a manner that he is bound to notice it, and generally when he is in an agreeable frame of mind.

When the coin is deposited an electrical contact is made and the sign is flashed into view



A jointed ring buoyed up by two floats rubs against the pile and scrapes off marine growths

Making the Waves Scrape Marine Growths from Piles

THE protection of wooden piling on wharfs and piers along our coasts from barnacles and the ravages of insect borers is a vital matter. Lives are endangered and much property is lost through worm-eaten supports. For that reason a "protector," installed at various points along the Pacific coast by Alva L. Reynolds, of Long Beach, California, is attracting considerable attention.

The device consists of a jointed ring which encircles the piling loosely and is buoyed up by two floats, which look like big wooden baits on rat-trap hooks, and prevent the iron ring from slipping to the bottom of the pile into the mud. Up and down with the tide goes this wooden-baited ring, constantly rubbing itself around the post and preventing the entrance of wood-borers, or, if the post be old and already covered, scraping off the marine growths and undesirable attachments of all kinds.

How an Entire Railroad Car May Be Moved by Hand

WITH a tool such as that invented by Charles McCarter, of Decatur, Illinois, any one can move a railroad car by hand. It has a clamp that firmly grips the car wheel when a lever (shown in the hands of the man in the photograph) is lowered. The lever has its end secured to a crank pivoted on a triangular wheeled frame, the wheels of which always rest on the track rail.

When the lever is raised, cranks release the clamp from its grip on the car wheel. As the lever is arranged outside of the track it may be operated without any hindrance where two cars are coupled, for there will be ample room to move the lever. The car wheel is rolled three inches at one stroke of the lever.

When the car wheel moves, the car-mover rolls on the rail and they both travel together. One man can move the heaviest loaded car on any kind of track. Slippery rails do not hinder the operation, and there is not the least danger of the operator getting his fingers or toes mashed or being hurt in any way.

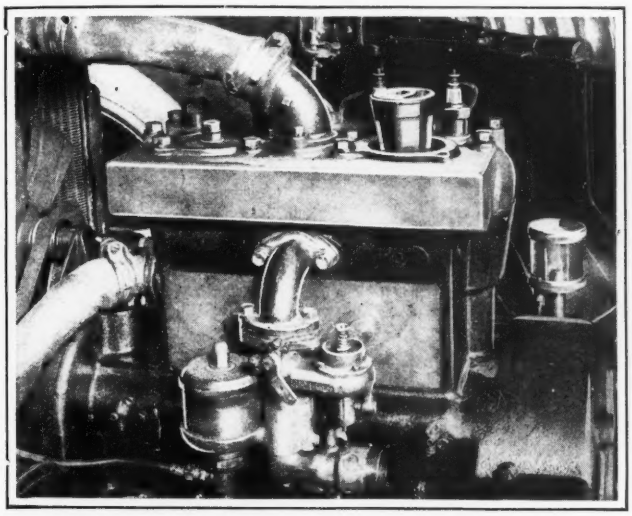
The tool and its frame are light enough to be easily carried where needed. It is especially useful where a car switched on a siding has come to a stop a few feet short of the desired place for loading or unloading. With the mover the car can be placed exactly where it is needed in a few minutes' time and without requiring the services of more than one man.

At each stroke of the lever the car wheel is moved three inches. Slippery rails do not hinder the operation

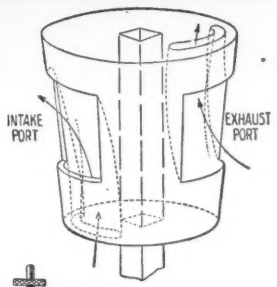
Eliminating Automobile Valve Trouble

Valves made of pure carbon are self-lubricating

ALL valve grinding, trouble with weak valve springs and loss of power through improper seating of valves would be eliminated if the motors were fitted with the carbon rotary valve shown in the accompanying illustrations. It is made of pure carbon in the shape of a cone with the apex cut off and is run small end down in a steel seat placed between the curvature of two or more adjacent cylinders. It is carried on a vertical shaft revolved by a pair of bevel gears driven off the engine crank-shaft. Two Boston men are the inventors.



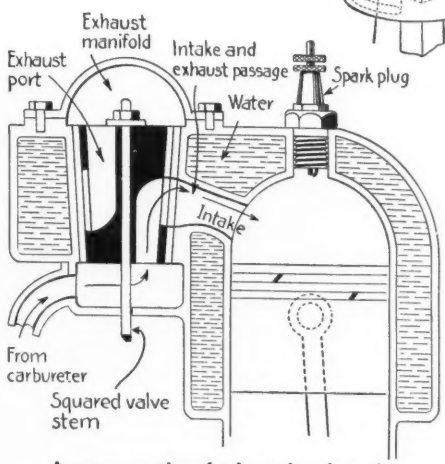
A four-cylinder motor with the cylinders cast in pairs. There is a valve for each pair



The two rectangular intake and exhaust ports in the curved sides of the valve

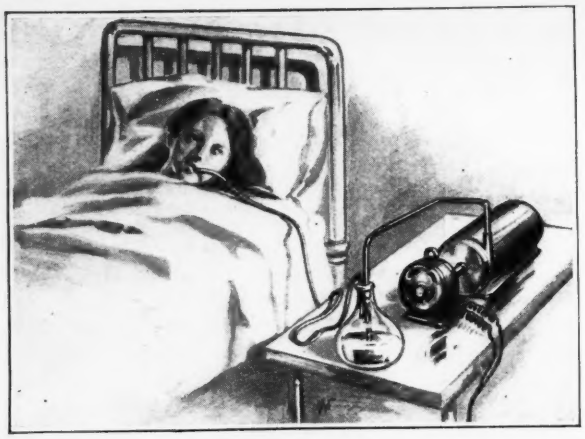
Carbon is one of the best lubricants known and has great heat resisting properties, so that the valve is practically self-lubricated and is yet able to withstand the heat of the exhaust gases without warping and sticking in its seat, a trouble heretofore always experienced to some extent with metal-against-metal rotary valves.

The illustration shows a four-cylinder motor with its cylinders cast in pairs and a valve for each pair. As shown in the drawings, the valve has two rectangular ports cut in its curved sides at points 20 degrees apart. A passageway is cut from one of these ports to the large top of the valve. A similar passage is cut from the other port to the bottom of the valve, the passages being on the same side of the valve as the port in each case. The opening in the top serves as the exhaust port and that in the bottom as the intake port.

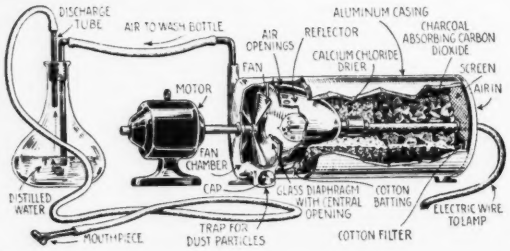


A cross-sectional view showing the construction of the valves and their relation to the engine cylinder

At the beginning and during the suction stroke of the motor, the valve is rotated in its seat so that the intake port in the valve is made to coincide with the port in the valve seat which opens into a passage leading directly into the head of the cylinder. The gas passes up through the crescent-shaped opening in the bottom of the valve, through the coinciding ports in valve and seat and thence through the passage leading to the cylinder where it is exploded in the usual manner. Then as the valve is rotated at half the speed of the motor, the latter has its compression and firing strokes before the valve has made one-half a revolution and the exhaust port of the latter is brought opposite the valve seat port to permit the burnt gases to pass through the valve and up into the exhaust manifold. The following half revolution of the valve takes care of the second cylinder.



The air supplied to the patient is mechanically cleansed by the filters, made chemically clean by the action of the rays from the electric light, and then carried to the patients' lungs through the mouth

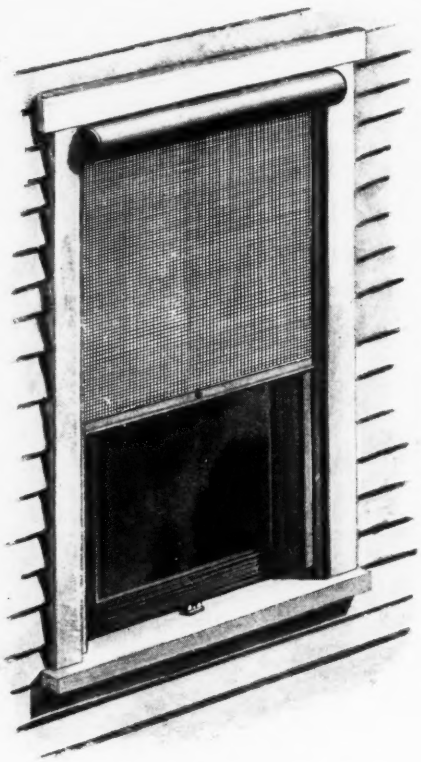


Apparatus for Purifying and Medicating Air

IN bronchial and throat affections and directly after suffocation by gas, prepared air is of the greatest value, especially if it is medicated. The apparatus illustrated makes it possible for a gas-stricken victim to be restored to consciousness in a minimum of time.

A coarse mesh at the point of entry contains a packing of lump charcoal which removes gases, excess moisture and solid matter. Solid calcium chloride thoroughly dries the air and then a layer of cotton wool filters it and prevents the solids from falling into the reflector chamber through the holes surrounding the reflector rim.

The air comes through these holes and is exposed to the glare of a tungsten lamp intensified by a bright metal reflector. The action of the rays combined with the heat of the lamp kills the germs and organic matter remaining in the air. A suction fan draws the purified air from the reflector chamber and disposes of any remaining particles by the centrifugal throw of its blades. This tends to push the air along its path, relieving the patient of much of the labor of drawing the air through the apparatus. In the final stage, the air passes through a tube into a saline or oil solution in a bottle, from which it is passed to the patient, through another tube.



The screens may be rolled up like a shade on cleaning days and left in their cases when the season is over

An Improvement on an Old Idea for Window Screens

ESLE V. MERCER has adapted the principle of the ordinary window shade roller to the mosquito screen. The roller used is of much larger diameter than that of a window shade, and it is fitted with a much more powerful spring. Moreover, it is entirely enclosed in a metal casing, mounted directly outside the window. The screening itself is reinforced by thin-edge strips of flexible metal.

When the screen is pulled down it is fastened in place by a catch on the bottom window-sill. When the cleaning day comes around, instead of having to remove each screen from its fastenings in order to get at the windows, it is necessary only to roll up each one in its turn. When the mosquito and fly season is over the screens need not be taken down and stored. They may be left rolled up in the cases.

Protecting Ships from Torpedoes

A U-shaped buffer is provided, in which the hull of the vessel floats

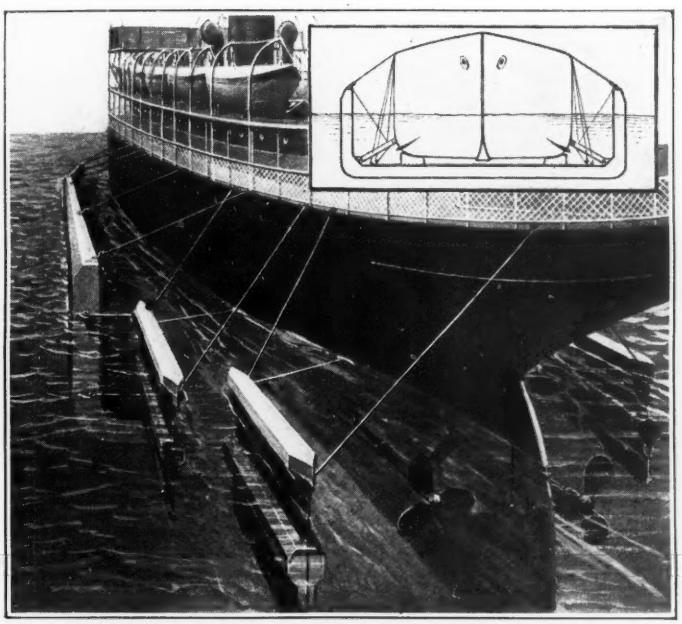
IS there no defense against the torpedo and the mine? Can nothing be done to protect a *Lusitania* or a *Laconia*?

Naval architects have succeeded in giving warships some measure of protection by subdividing their hulls into literally hundreds of cells. When the battleship *Audacious* struck a mine she stayed afloat for over four hours because of her multi-cellular construction. Why is not the same idea applied to merchant vessels? Simply because it is prohibitively expensive.

Even so, the *Lusitania* was built not unlike a warship; for she had a double hull and was subdivided after a fashion. Because she was not minutely subdivided, like a battleship, she went down in twenty minutes.

Why not use torpedo nets? They have proven of no avail. But the idea of catching a torpedo and stopping it before it ever reaches a ship seems sound. Accordingly, we find that Thomas Thurston, a naval architect connected with one of the large British shipbuilding firms, has invented and patented a system for protecting ships from the effects of a submarine explosion, which system depends on the principle of providing a buffer for a ship.

As the illustration shows, Thurston's buffer is a U-shaped structure, not unlike a floating dry-dock, in which floats the hull of the vessel to be protected. This U-shaped structure comprises side walls connected by a bottom which lies beneath the ship's hull. The U-shaped structure lies at a suitable depth so that the ship to be protected can be floated in and secured to the structure. Since the protecting structure is merely a shell, it offers but little resistance to the water.



The protecting U-shaped structure is composed of side walls connected by a bottom beneath the ship's hull. It is a mere shell, as may be seen from the diagrammatic drawing

It is evident that if a torpedo or a mine were to explode, the U-shaped protector would be destroyed, but the ship itself would be saved.

Even if the ship were damaged to some extent the injury would probably be slight and could be easily repaired by the ship's mechanic.

The Perfect Poise—How We Can Attain It

FOR the perfect physical poise we don't need to study pictures in the modern magazines. The ideal form is well expressed in sculpture dating back to 500–600 B. C., when the Spartans were masters of Greece. These ancients carried themselves in such a way that the muscles, organs, circulation and even the brain and nervous system were placed in harmonious relationship. How can we attain the same poise in walking? Briefly, by setting the shoulders back and squaring them evenly, by carrying the chest high and well arched forward, by keeping the stomach in and the neck perpendicular, like a column, and by forcing the chin in. Whether sitting, standing or walking, these principles involve a correct and graceful carriage.

A reaper boat cutting aquatic growths. The blades lie near the bottom of the pond and operate automatically by motor-power

Clearing Out Ponds and Lakes with a Reaper

WE are familiar with all sorts of reaping and harvesting machines designed for use on land, but a reaper boat is something decidedly new. A Frenchman by the name of Amiot has devised a boat which is equipped with a set of cutting blades for use in removing aquatic growths from ponds and artificial lakes.

The cutting blades, which are modeled after the fashion of reaper blades, are operated by a motor on the boat. The boat is about twenty feet in length, flat bottomed and narrow at the front and rear. A paddle wheel placed in the front of the boat is driven by a gasoline engine.

The cutting bars are placed at the rear end of the boat on a vertical frame. The blades are made in different lengths and with different curvatures to adapt them to the irregularities of the stream beds. The frame which supports the cutting blades is constructed of two vertical irons and may be swung from a lever pivoted in an upright.

The paddle wheel is carried on a frame capable of adjustment to any desired depth. The wheel is driven from the gasoline motor by a gearing and chain device. Two separate countershafts are used for this purpose so as to give the necessary speed reduction when cutting. The cutting frame may be lifted out of the water when not in use. The blades fold up alongside the frame.

A Willow Basket as Large as a House

THIS huge basket, a product of a tribe of the Ponca Indians of California, weighs 325 pounds when empty, notwithstanding that it is made of light osiers, skillfully intertwined. It is six feet from bottom to rim, and its top is three feet higher.

It is now the property of the Institute of Arts and Sciences of Brooklyn, New York. Before it could be loaded on a box car for shipment east it was necessary to widen the floor of the car.

These huge willow "granaries" of the Poncas are generally mounted on rude platforms reached by ladders to keep them dry. Each basket has a rain-shedding cover made of grass or cedar bark. The grain kept in them remains dry and in perfect condition indefinitely.

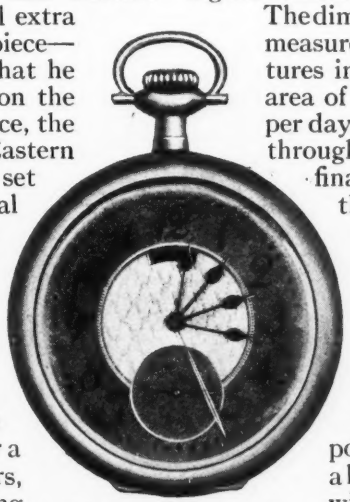
An entire family could be sheltered in this great basket, which was formerly used by the Indians as a granary

Making Your Watch Tell the Whole Truth

THE average commercial traveler who journeys about the United States has to keep a close watch on his timepiece to see that it is telling the truth. There is an hour's difference in time when you enter and leave some cities and it's an important matter that you do not forget to set your watch back or forward an hour, according to which way you are traveling. If you overlook it, you may miss a train.

An express official who travels almost all the time and is so busy that he sometimes forgets to change his watch at Detroit, Mich., for instance, or at Dodge City, Ia., has frequently had an experience of this kind. Sometimes he has arrived an hour ahead of time or, perhaps, an hour after a train has left, giving him time enough for reflection.

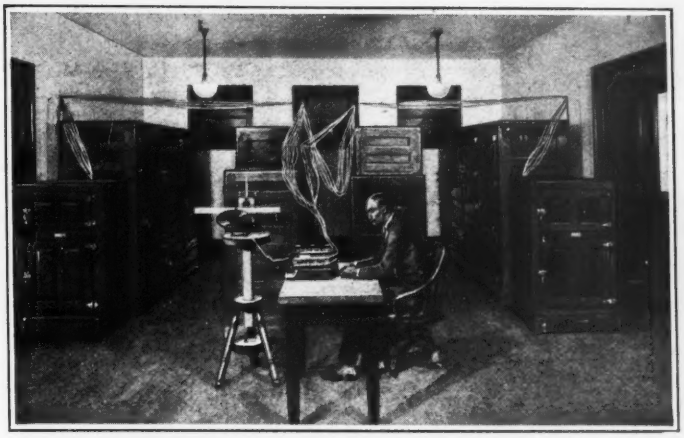
Recently, he conceived the idea of making his watch tell all four different times—Eastern, Central, Mountain and Pacific. He went to a jeweler and had extra hour hands put on his timepiece—each of a different color, so that he can recognize it at a glance, on the face of his watch. For instance, the ordinary hour-hand, set at Eastern time, is silver; a blue hand, set an hour back, represents central time; a red hand, for mountain time, is set two hours back; and a green hour hand, three hours back, represents Pacific time.



You can have additional hands made for your watch so that it will indicate the time of the locality you are in

You can do this to your own watch. The jeweler will make a set of hands of these colors and alter your watch for a consideration of a few dollars, so that when you go traveling it will not be necessary to disturb the mechanism of your watch by setting the hour-hands back and forth frequently, according to whether you are in Detroit, Chicago, New York, Denver, San Francisco, or other places on the map.

But such an arrangement would be particularly useful only to the itinerant salesman or other frequent traveler.



The tests relate to ice consumption, temperature distribution, and air circulation within the refrigerators. Equipment inside each refrigerator is connected with the galvanometer

How the War Department Tests Its Household Refrigerators

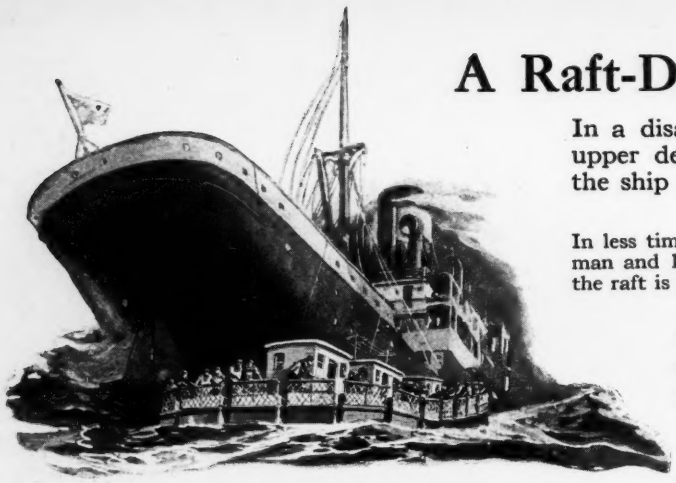
ACCORDING to the Bureau of Standards, the ordinary household refrigerator, even of the best make, is by no means as effective in the saving of ice as might be desired. Before awarding contracts to supply the army with refrigerators, the War Department uses temperature-measuring instruments for testing each type offered. The dimensions of the refrigerators are measured, as well as the temperatures inside and outside, the size or area of ice used, the amount melted per day, the amount of air circulating through the food chambers, and, finally, the heat transmission of the refrigerator walls.

The temperature measurements are made by means of thermocouples (instruments for noting differences in temperature by electricity), several of which are mounted inside each refrigerator and several others at various points outside. By this means all measurements are made with a single galvanometer (an instrument for measuring the intensity of an electrical current), shown on the tripod stand in the illustration. The lead wires from each of the thermocouples, some thirty in number, are connected successively with the galvanometer by means of the simple switchboard on the table.

The temperature is measured in the air entrance and the air exit to the ice chamber.

A Raft-Deck Life-Saver

In a disaster at sea a detachable upper deck slips over the side of the ship and becomes a giant raft



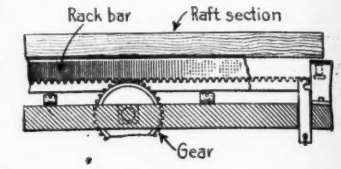
In less time than it would take to man and launch a single lifeboat, the raft is floated with all on board

A GIGANTIC raft capable of holding all the passengers and crew at one time, is the newest life-saving invention of Nathan Rubenstein of New York. It consists of a number of wooden sections joined together and mounted on airtight pontoons set down on the uppermost rear deck of the vessel. When not in use as a raft it forms an integral part of the ship and is used as a promenade deck.

When a vessel has received its death wound and lists dangerously over to either side, the raft is merely released from its moorings so that it can slide over the lower rail into the water. When it has been launched successfully, the passengers slide down to it in canvas bags or on ropes and suspended seats like breeches buoys. The raft is equipped with small cabins for food and with a complete wireless telegraph outfit.

The evident advantages of a raft of this type are comprised in the fact that it saves life wholesale and is launched and manned with all on board in less time than would be required for one of the twenty or thirty conventional life-boats that are usually carried. The fact that it takes up no space that might be used for other purposes is also an advantage, and its wireless outfit is perhaps its trump card.

Against these advantages it is wise to consider the fact that such a raft places the passengers and crew in the position of the eggs which the old woman carried all in one basket. It is a case of all being saved or none. Again, due to its great size, it is liable to be damaged or to capsize in launching, or to be torn from its moor-



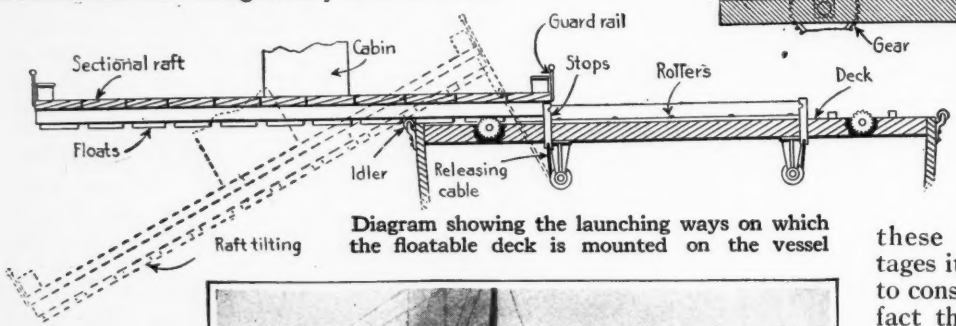
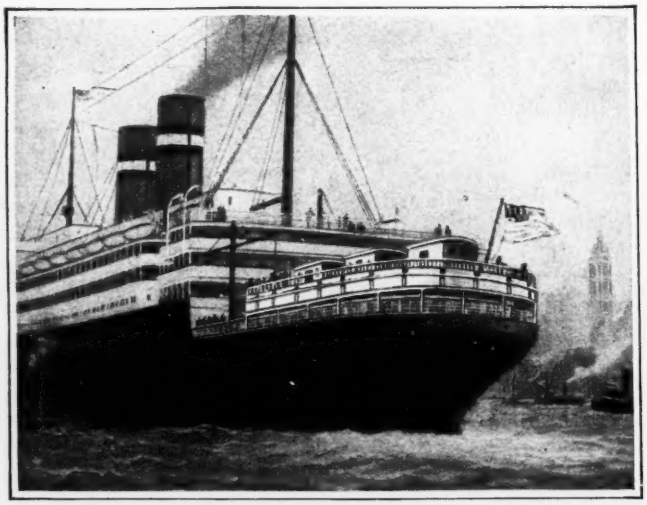


Diagram showing the launching ways on which the floatable deck is mounted on the vessel



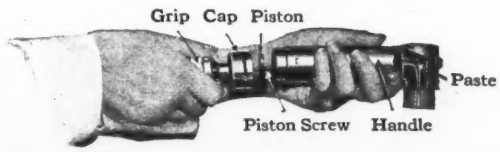
The deck-raft as it appears ordinarily on an ocean liner. It is used as a promenade for the ship's passengers

ings during a storm at sea. It is not an unheard-of occurrence for mountain-high waves to strike a ship with a force of several hundred tons and make her tremble and shiver down to her keel. In such a case there seems little to hinder the raft from jerking free and sliding of its own accord down into the sea, leaving the passengers and crew without hope of escape. Even at best the chances of launching it successfully in such a sea would be small, in spite of its specially devised launching ways.

In place of a second man to guide the large saw, a carriage is substituted on which the saw slides back and forth

A Fountain Shoe-Shining Outfit. It Won't Soil Your Hands

THE trouble and the discomfort that accompanies shoe-shining at home can be eliminated by a fountain-brush that Theodore F. Gensmer, of Minneapolis, Minnesota, has invented. A long tube of paste fits safely inside the polish-brush handle. The simple turning of a finger grip at the end of the handle pushes in a piston and forces as much paste down into the bristles of the brush as is wanted. When the tube has been used up, another is inserted. In this way the hands do not come into contact with the polish or the shoe. Furthermore, the device prevents any waste of the polish, since the finger grip must be operated before the polish is forced down into the bristles. The felt brush polisher gives a better finish than the usual cloth. The paste container fits into a metal-lined cavity in the brush.



By a simple twist of the grip on the handle a piston is forced up in the cylinder and the paste is pressed down to the bristles. It is spread with the dauber as shown on the left. A felt brush is used for the polishing and shining

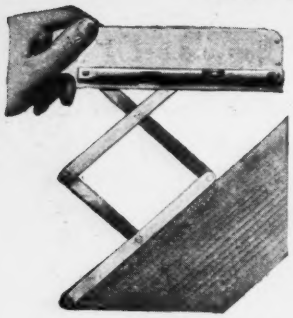
A One-Man Saw for Felling Large Trees

ALL large cross-cut saws for felling big trees require two men to guide them. By the use of an ingenious guiding mechanism, however, Frank C. Ridson, a Canadian, has been able to do the work with one man. The end of the saw is simply bolted on a carriage which moves horizontally back and forth on guide rods mounted on the tree when the sawing is in progress.

The guide rods swing on a spindle which is driven into the tree. They are held steady by a lower sleeve to which the rod sleeve can be locked. A strong spring fastened in back of the tree holds the rod sleeve and prevents its turning.

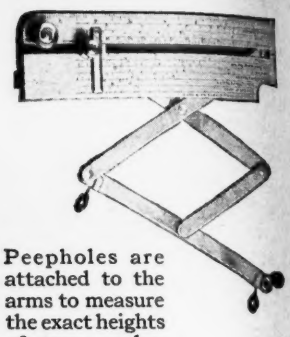
The rods guide the carriage in a direction parallel with the cutting movements of the saw. This reduces the sliding friction to a minimum.

Do It with Tools and Machines



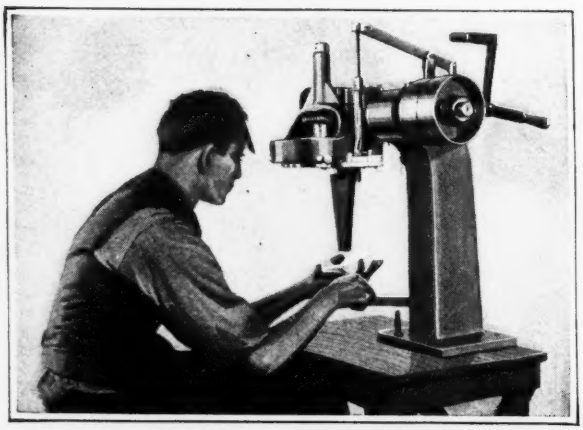
Finding the inclination of a plane with a simple computing square

A handful of sparkling diamonds used by an automobile manufacturer in truing grinder wheels

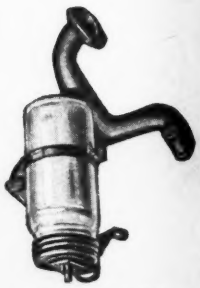


Peepholes are attached to the arms to measure the exact heights of trees, poles, buildings, hills, mountains and landmarks

An apparatus for electro-mechanical massage. It is used to relieve neurasthenia and constipation



Manufactured screws are thrown in the hopper and the machine counts and delivers them to the packer

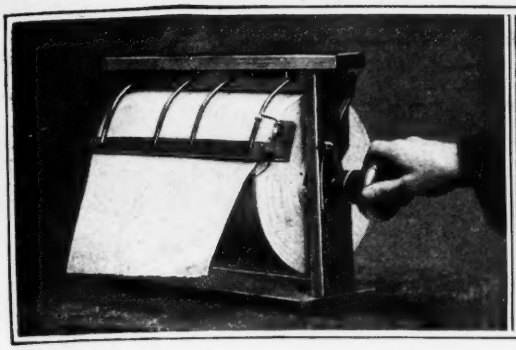


Jar for holding water to supply moisture at all times to the intake manifold of the automobile engine

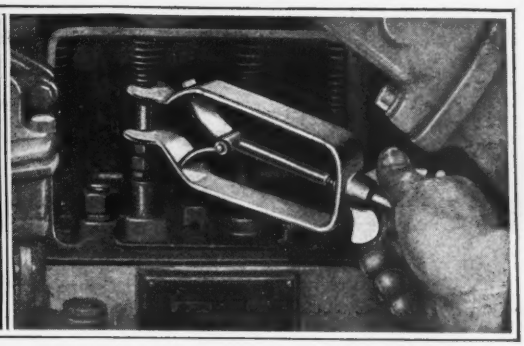
A trestle with toggle levers to hold a board during the planing process

A quick-return screwdriver is a valuable addition to the automobile tools

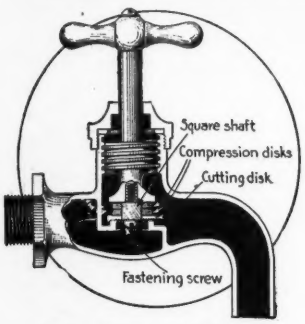
Do It with Tools and Machines



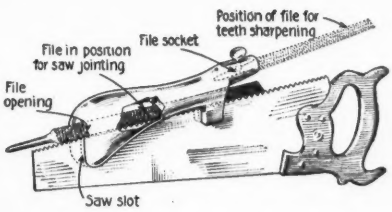
The paper-roll holder has a cutter attachment which is operated by a slight pressure of the thumb on the handle that turns the roll



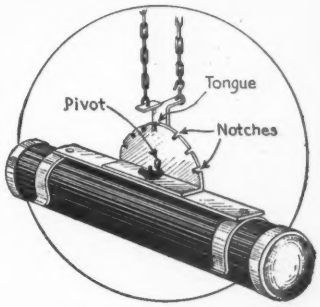
A two-way valve tool used to remove the cotter or to compress a spring by the action of a thumbnut, the jaws working both ways



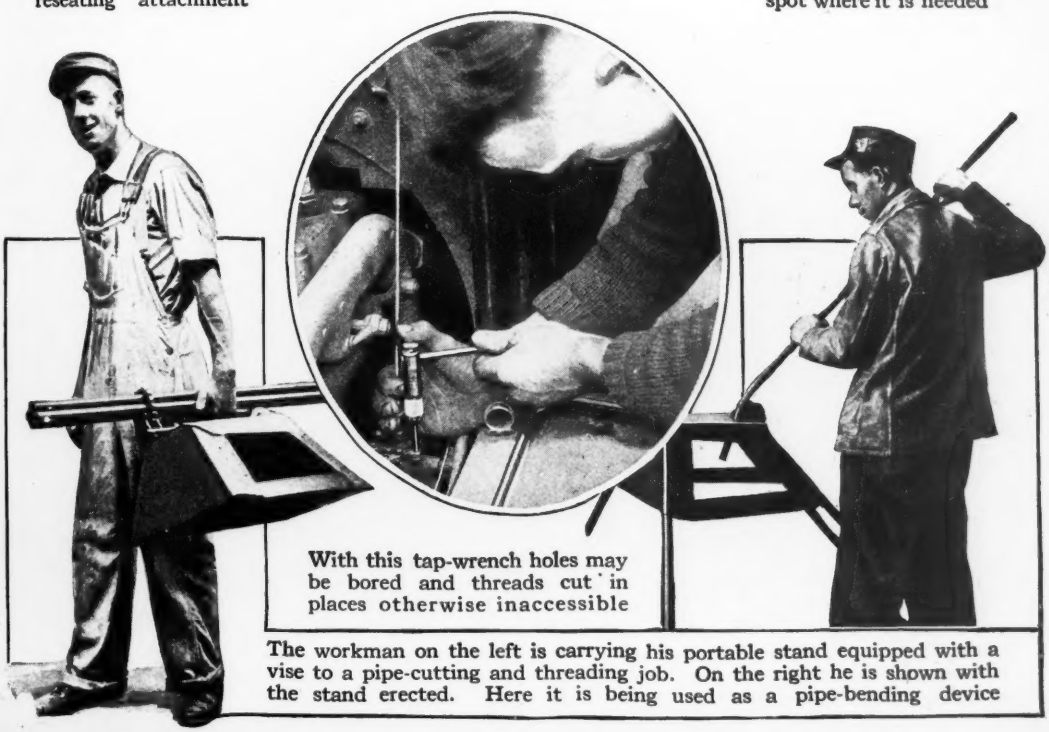
Valve disks which have become pitted and rough can be quickly smoothed up with this reseating attachment



By the use of this handle a three-cornered file may be held in two different positions for jointing and filing the teeth of a saw



A flashlight holder for the use of the mechanic to enable him to direct the light to the exact spot where it is needed

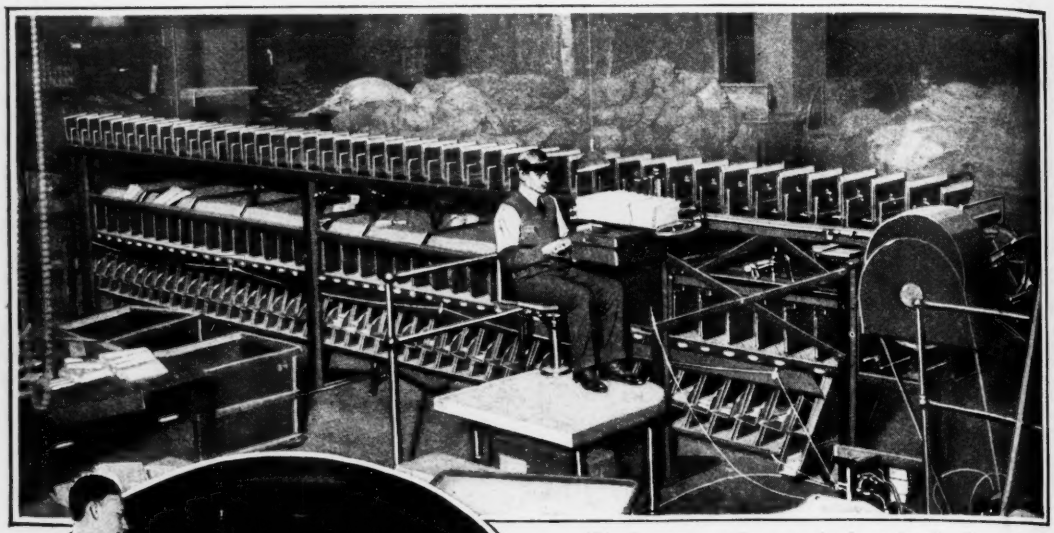


With this tap-wrench holes may be bored and threads cut in places otherwise inaccessible

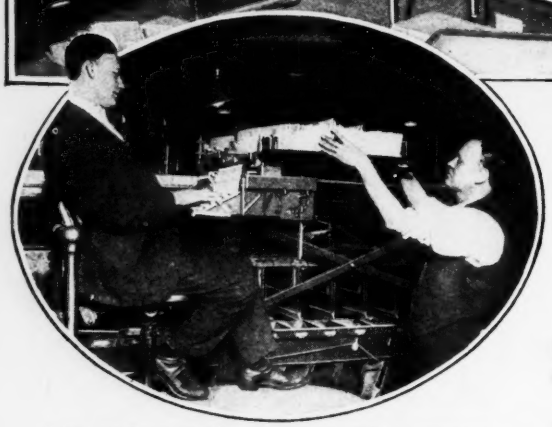
The workman on the left is carrying his portable stand equipped with a vise to a pipe-cutting and threading job. On the right he is shown with the stand erected. Here it is being used as a pipe-bending device

Sorting Mail with a Typewriter

A wonderful mechanical system which does away with the services of thirty men



The letters are first stacked mechanically and faced up so that the address is in sight. The 256 keys control as many combinations of rods



The endless chain conveyor which carries the letters to the "buckets" for distribution

THERE is a new mechanical sorting and distributing system in the Chicago, Illinois, post office. It is a device by which letters to all parts of the globe are separated into 256 different divisions—a sorting which at present in all other post offices means two handlings of each piece of mail, and the employment of a small army of case clerks. Hoboken? Honolulu? Zip! Zip! Two taps on the typewriter keyboard, and the letters are on their way!

An endless chain conveyer travels horizontally around two drums, at the left of the operator. This endless belt carries a series of metal pigeonholes below a smaller number of large containers known as "buckets," which are the first destinations of the sorted letters. At the bottom of each bucket are four small rods projecting downward. Each of these rods works independently of the others, and is capable of four different positions. Thus we find 256 possible combinations.

The metal vane, swinging back and forth, deposits the letters in the buckets, where they are taken care of by the rods.

The letters come before the operator of the keyboard after having been stacked by a mechanical contrivance which faces them up and presses them in with sufficient tension so that the address of the foremost missive is in plain sight always.

The keyboard consists of 256 different keys to correspond with the 256 combinations of the rods. The means of transmission from the keys to the rods is through an arrangement of horizontally placed levers along which the four bucket-rods pass.

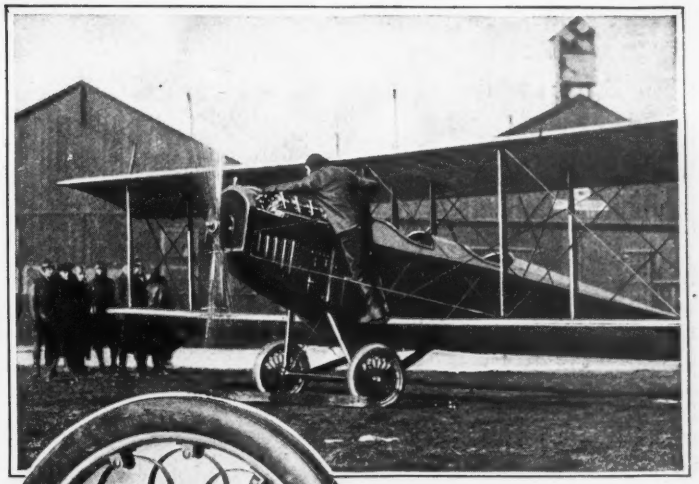
The operator glances quickly at the address on an envelope, presses the key which corresponds, and the letter flashes away. The one pressure sets the horizontal levers at the correct combination. These act on the four rods of the bucket so that when the metal vane carries the letter to the bucket, the rods pass it on down instantly into one of the pigeonholes beneath. The same pressure of the key brings the next letter in position.

A New Airplane Wheel Which Absorbs Shocks

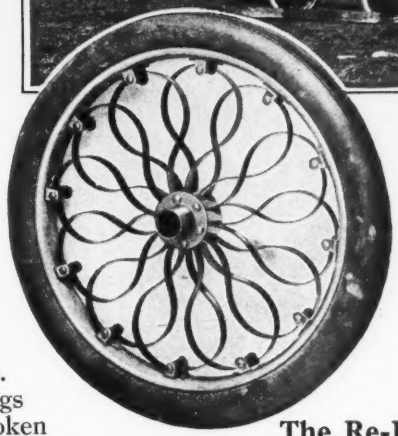
IN all wheeled vehicles it is essential that shocks should be absorbed as far as possible by the tires themselves. In other words, the brunt of the shock should be absorbed before it is communicated to the springs and thus to the body of the vehicle itself. For, when the axle and the wheel are set in vibration, the springs, no matter how plastic, will communicate a part of that vibration, to the body. This is equally as true of airplanes as of automobiles.

With pneumatic tires the main force of a concussion is immediately absorbed by the resilient rubber. That is one reason why airplane wheels are equipped with pneumatic tires. No wheels are exposed to such severe shocks as airplane wheels. Indeed, even the ball bearings in such wheels have been broken in making landings, so great is the force of the impact. The blow given to an airplane wheel when landing is severe, and the ground over which it travels before it comes to a rest is rough. Thus a wheel to bear up under such abuse must not only be able to withstand a crushing force but it must absorb sidewise blows as well. The very best and most up-to-date automobile spring device is of little permanent value, therefore, to the airplane.

The new airplane wheel illustrated is said to meet all these requirements. It absorbs shocks before they reach the axle and reduces bouncing to a minimum. Even over uneven surfaces it affords easy riding for the aviator. Thus it is possible for the airplane to start and land on rough ground. Furthermore, with all violent shocks absorbed by the wheel before they are communicated to the body, the life of the airplane is noticeably lengthened and its usefulness enhanced.



The two front wheels of the airplane sustain practically the entire weight and receive the roughest kind of usage



The new airplane wheel which is so designed that it will absorb shocks and reduce bouncing to a minimum

The Re-Inking Roller for Typewriters. It Saves the Cost of a Dozen Ribbons

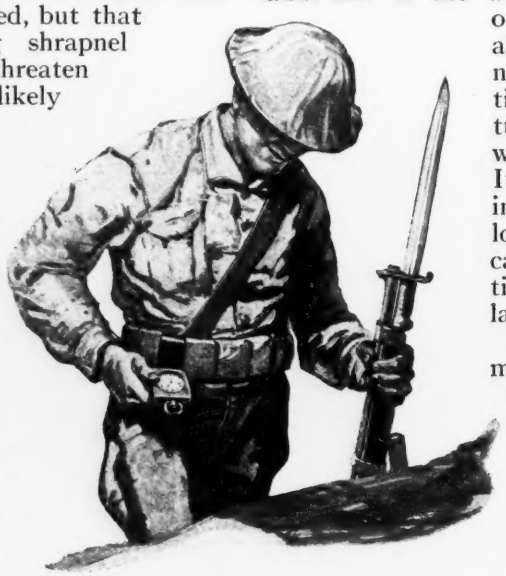
WHEN the ribbon on your typewriter has dried you can ink it again. The inking device consists of a small roller to which the ink is fed by a sort of fountain-pen arrangement. The ink is poured in the cylinder back of the roller. A short padding of felt juts from the end of the cylinder on to the roller. This piece of felt not only prevents the ink leaking out but, like a wick, it keeps the roller moistened. When the ribbon is run through the machine against the turning roller, it is thoroughly inked. If the ribbons are handled carefully the device will save the cost of a dozen new ones and give service indefinitely. A specially prepared ink is used. It will not smudge and it is easily absorbed, so that the type striking against the ribbon give clear cut, neat letters.

The felt wick feeds the ink from the holder to the roller. Drawing a ribbon over the roller makes it as good as new

The Upside-Down Watch—Successor to the Wrist Watch for Soldiers

THE wrist watch, which rose so high in popularity on account of the endorsement given it by men of the army and navy, has retired to second place in the soldiers' favor. The reason for this is not that this style of watch proved to be less convenient than it promised, but that bullets and bursting shrapnel which constantly threaten the exposed men are likely to strike the arm wearing the watch and drive bits of broken glass and metal into the flesh, thus aggravating the wounds.

The watch which now holds first place (it was invented by R. A. Hempel of Berlin) is worn suspended from the belt by a loop of leather. The loop ends in a pocket into which the watch fits, as shown in the illustration. The front surface of the pocket has a circular opening through which the face of the watch shows. A small strap encircles the watch and fastens it securely in place, buckling on the outside of the pocket. The watch hangs top-downward, but when the wearer raises it in his hand or glances down at it as it hangs from the belt, it is in just the proper position to be read. If it should happen to be shattered by a bullet the particles of glass or metal would be caught and held in the leather case so that they would do no harm. Many a fighter has had to thank the watch on his wrist for stopping a bullet that might have necessitated the loss of an arm. The very fact that the upside-down watch is carried against a more vulnerable part of the body than is the wrist watch, makes it all the more valuable as a protective medium. It may be worn under the cartridge belt.



The watch appears upside-down to everyone but the one who is wearing it

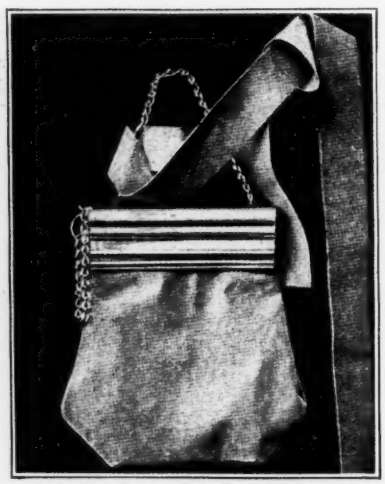
Covering Steam Pipes with a Glass Lighter than Cork

SPUN glass, which consists of extremely fine glass threads, is being used in Germany as an insulating material to retain the heat in steam pipes. Since it is considerably lighter even than cork, it adds less to the weight of the pipe than other insulating materials. Furthermore, it is not affected by vibration, by high temperature or by the action of water, steam or acids. It retains its pristine insulating power after long lapses of time, and can be used a second time, because of this lack of deterioration.

Successful experiments reveal the fact that the admirable insulating capacity of spun glass is due to the air held in the interstices and to the mirror-like surfaces of the glass, which constantly reflect the heat.

The Summer Girl Carries Her Vanity Case Even Into the Surf

THE feminine bathing suit has graduated from the ranks of the purely serviceable into the class of artistic creations. Many and varied are the styles and colors which its scant breadths display. But in many instances the effect of the costume is marred by the unattractive rubber cord and brass bath-house key which the bather wears around her neck. The latest addition to the up-to-date suit, however, is a belt strap from which a waterproof bag is suspended. In this not only the objectionable key but jewelry and other valuables may be kept in safety. The bag is made of a rubberized material and it is fastened securely with a rust-proof clasp.

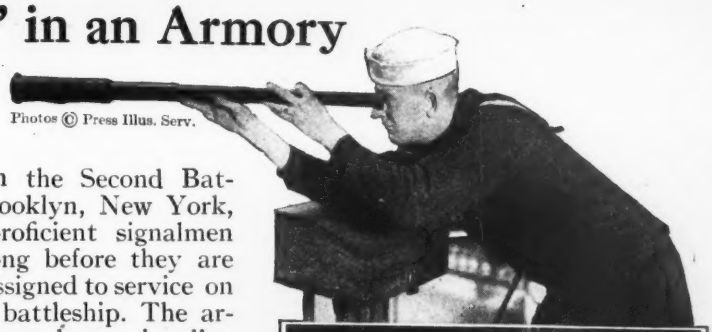


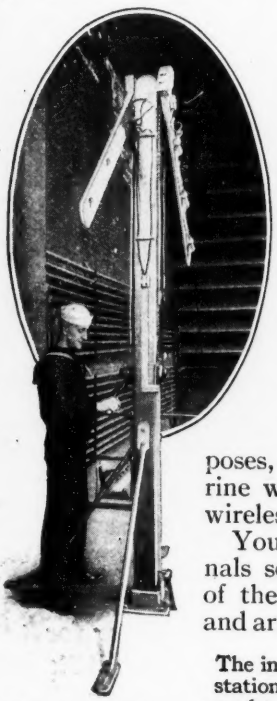
The surf bather's receptacle for her valuables and bath-house key

"Going to Sea" in an Armory

THE making of expert signalmen no longer begins at sea, but at our naval training stations and in some of our armories. In the Second Battalion Naval Militia, at Brooklyn, New York, young men are turned into proficient signalmen long before they are assigned to service on a battleship. The armory has a signaling equipment as complete as that of a modern man-of-war.

Photos © Press Illus. Serv.



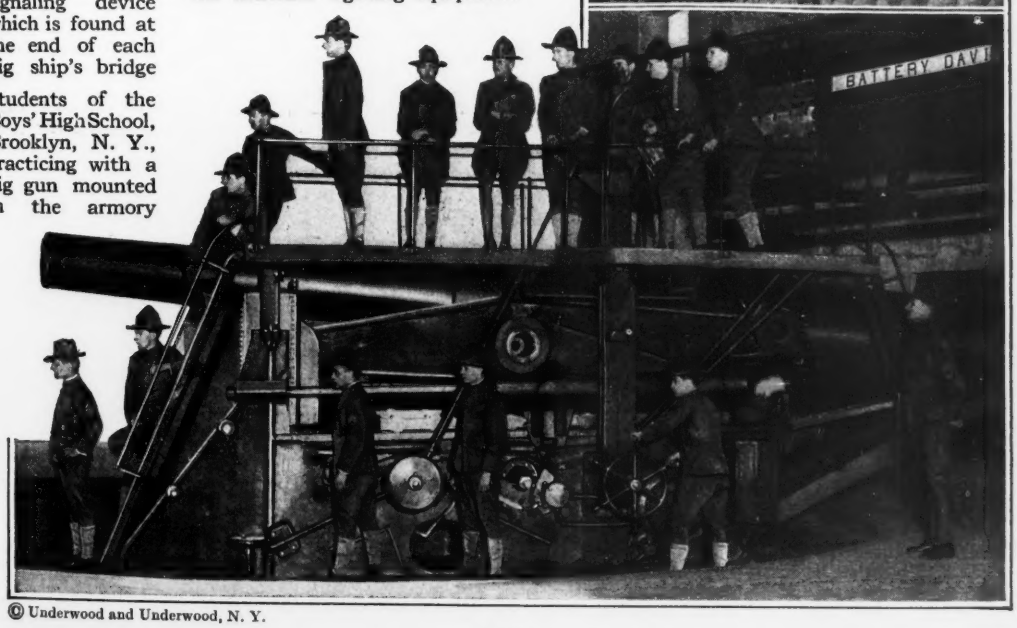


The semaphore signaling device which is found at the end of each big ship's bridge

Warships are great talkers. There are flags and semaphores for carrying on conversation by day, Ardois lights, blinkers, searchlights and rockets for night use, code and distress signals for special purposes, whistles and submarine warning signals, and the wireless telegraph.

You have seen the signals sent out from the ends of the flying bridges by posts and arms that look like "jump-

The interiors of the naval training stations are made to resemble the modern war vessel in design and the intricate fighting equipment



Students of the Boys' High School, Brooklyn, N. Y., practicing with a big gun mounted in the armory

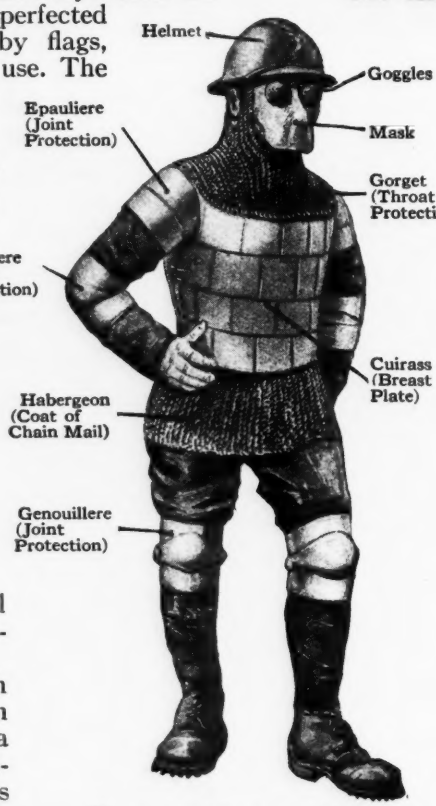
© Underwood and Underwood, N. Y.

ing jacks." They are semaphores, made of wood or metal and operated by levers. Before the semaphore was perfected orders were signaled by flags, which are still in limited use. The semaphore now signals twice as fast as the best wig-wag man. When the distance is too great for the semaphore, the big red and white flag still spells out the messages.

Signal flags, or hoists, are always used when the fleet is in battle or maneuvering at sea. For the flag hoists, as they are called, there are twenty-six flags of the International Code, one for each letter of the alphabet. This code is used by all navies and the merchantmen of all nations.

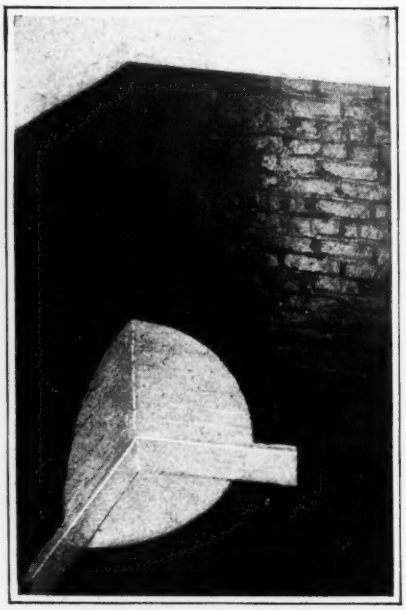
Of course each navy has its own secret code, written in a code book, which is jealously guarded. Its loss is a court-martial offense. It is weighted with lead. If a ship is captured it is thrown overboard. At night the red and white lamps of the Ardois are flashed. But yard-arm blinkers which signal dots and dashes in short and long displays, are supplanting the Ardois because they are faster. Small searchlight lanterns are now being used on the bridges of our fighting craft. One ship can lie at one entrance to the Panama Canal, and signal across Culebra Cut to another at the opposite entrance with ease. Then there are wireless and rocket signals, whistles and submarine signals—all included in the equipment of the armory shown.

Should Our Soldiers Dress Like the Ancient Crusaders?



How our soldiers would look in the proposed French suit of mail

GETTING its inspiration from the valuable service already performed by the steel helmet, *La Nature* of Paris suggests that the soldier's entire body should be encased in armor. It proposes that the sides of the head, neck and upper part of the chest be covered with a gorget, a kind of collar, and the loins with a kind of skirt, like the lower part of an habergeon, both in chain mail. A cuirass, or breastplate, of movable plates of steel would protect the chest and back, and hinged-steel elbow-pieces and knee-pieces would cover the joints. A face mask and goggles would complete the suit. The armor would be light enough to afford perfect freedom of action.



To stop spitting in corners, paint them white

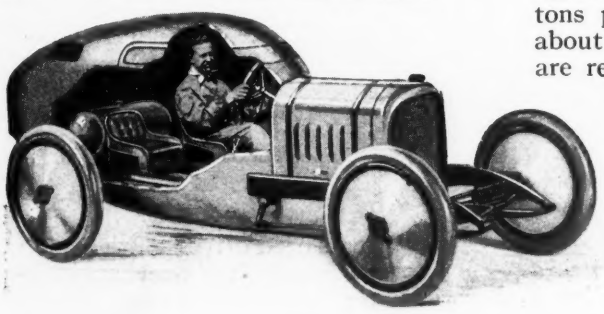
A Substitute for the "No Spitting" Placard

A LATHE manufacturing shop in Brighton, Mass., has devised a plan to protect corners of stairs and hallways from the thoughtless spitter, without placarding the walls with "No Spitting" signs. The reminder used is simply brilliant white paint which shows up the corner in spotless cleanliness. It has been found to be even more effective than the old signs, in spite of the fact that it carries no threat of a fine; for a man would require more than the ordinary amount of nerve or disregard for the proprieties to allow him to mar such whiteness.

It's Built Like an Egg, is Barney Oldfield's Racer

THE ordinary racing car, because of its shape, creates air eddies and currents that force the car to push a mass of air along in front of it and pull along another mass in back of it by suction. It requires a certain amount of power to move these masses of air. This leaves less for the actual propulsion of the vehicle whose speed is correspondingly decreased. Hence greater speeds than ever before attained by racing automobiles should be made possible by the unusual egg-shaped body which Barney Oldfield, the famous automobile racer, had made for him. Except for the projecting hood over the engine, Oldfield's car is the nearest approximation to a perfect streamline body ever made. Even the pan under the engine is blended into the body in such a manner as to present as little surface as possible against the propulsion of the car through space. The body is completely enclosed and has none of the usual flat surfaces and angles.

Automobile makers have learned much from the aeroplane builder concerning the construction of bodies that part the air easily and so cut down wind resistance. The body is made of aluminum and will be mounted on one of the cars to be seen at the racetracks this season.



Wind resistance reduces speed. The air should be smoothly parted by a correctly designed bulk. That is the underlying theory of this unique racer built for Barney Oldfield

Placing the copper eagle at the top of the giant flagpole

Placing the American Eagle On Its Perch

IN Baltimore, recently, there came a call for a dare-devil to ascend the fifty-five-foot steel flagpole on the roof of an office building and place upon its top, three hundred and thirty feet and some inches above the street, a gilded eagle that would lord it over every other artificial bird in the city. Two young steeplejacks tackled the job without delay. One of them carried the copper eagle to the top of the pole and in a high wind made it fast, while the other, as shown in the illustration, stationed himself midway up the pole to be near at hand if anything went wrong.

The eagle weighs thirty pounds, it is five feet high, and the spread of its wings is ten feet. The topmost steeplejack had to rivet it in place with two bolts, besides working with his pliers and a refractory piece of sheet-iron. It wasn't long, however, before he had the eagle fastened to its permanent perch. Most old-time steeplejacks shun steel poles. They say they are treacherous, snapping off at the top without the slightest warning.

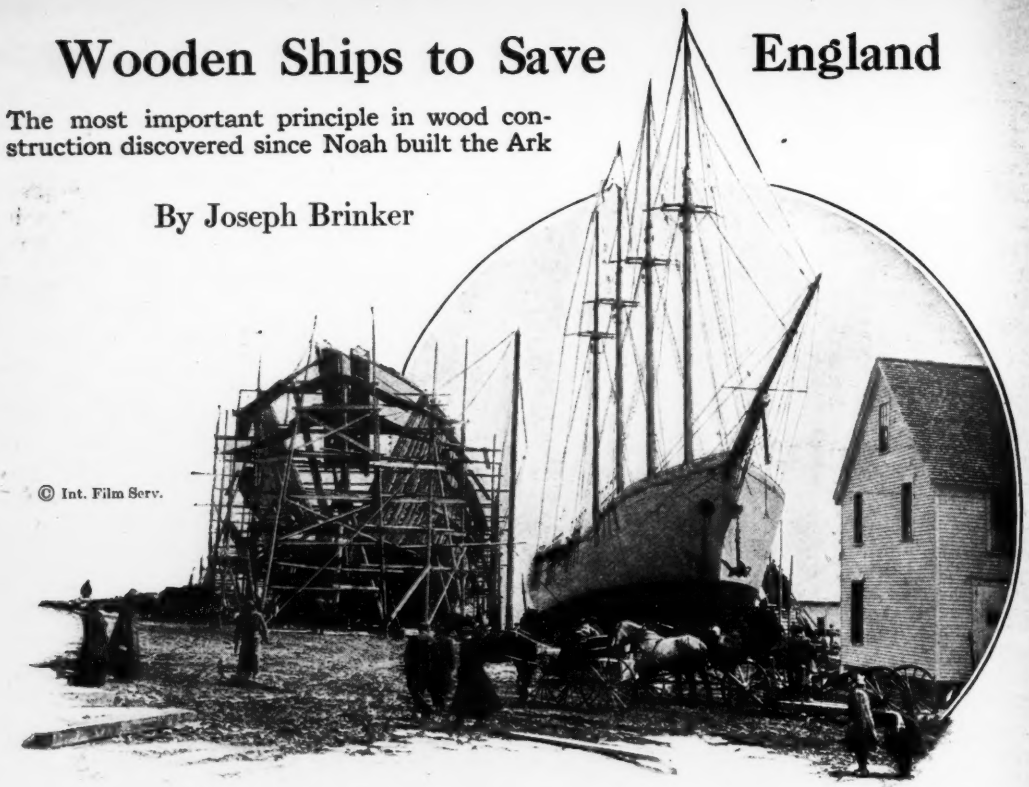
Our Newspapers Are Wiping out Our Forests

THE present demand for news print is estimated to be about six thousand tons per day. To supply this demand, about three million cords of woodpulp are required annually. To meet the demand for magazine and book paper, stationery and business papers of all kinds, wrapping paper, wall paper, cardboard, fiber board, and the like, four million cords more of wood pulp are needed annually. Because the production barely keeps pace with this consumption, the Federal Trade Commission is considering means for the better distribution of the product.

Wooden Ships to Save England

The most important principle in wood construction discovered since Noah built the Ark

By Joseph Brinker



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New England has witnessed a rebirth of the shipbuilding industry. One thousand wooden vessels are being built in yards which have been idle since the days of the great American merchant marine

SHIPS, ships and then more ships is the crying need of Great Britain to her new ally America, as expressed recently by Lloyd George, in a speech to Americans in London. England's foremost statesmen realize the seriousness of the submarine problem. Submarines are being built faster than they are being sunk; merchant tonnage is being sunk faster than it is being built. The submarine must be conquered.

England looks to America for help. New merchant marines must be launched quickly if they are to be of any avail. Without ships, we cannot deliver the supplies that we must throw into the balance.

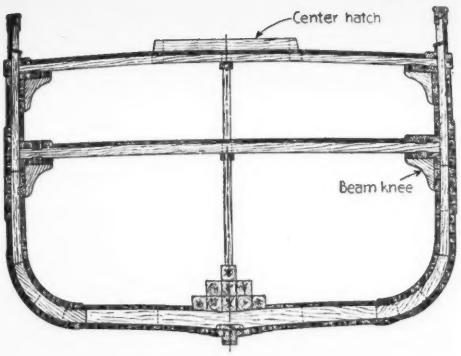
Yankee ingenuity has risen to the occasion. While ship steel is scarce because of the great demands upon the steel industry for ammunition, rails and other kindred supplies, wood is plentiful and readily available. The problem thus resolves itself into one of providing the means whereby wood can be utilized for ships of sufficient tonnage to make their operation commercially feasible.

William T. Donnelly, the designer of the new wooden ship capable of carrying more than five thousand tonnage

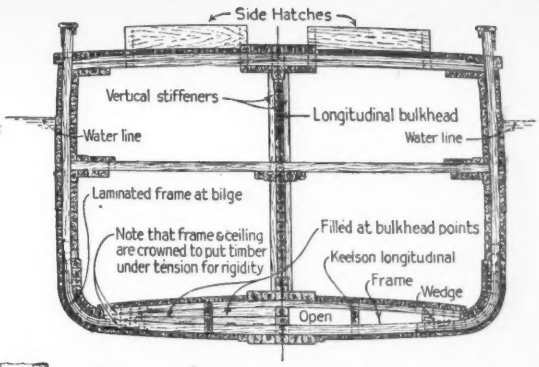
William T. Donnelly, a New York engineer and naval architect, has devised a construction for wooden ships capable of carrying 5,500 tons of freight, or approximately twice the amount which any type of wooden ship heretofore built has been able to carry. His new design provides for a vessel 350 feet long, 50 feet beam and 30 feet deep. The new type of boat is almost entirely of wood. In each ship 1,500,000 board feet of southern yellow pine take the place of 2,300 tons of steel.

Why Steel Took the Place of Wood

In the past, wooden ships have been driven off the seas by vessels made of steel not because the former were made of wood but because wooden ships had to be made smaller. Why smaller? Because our naval architects did

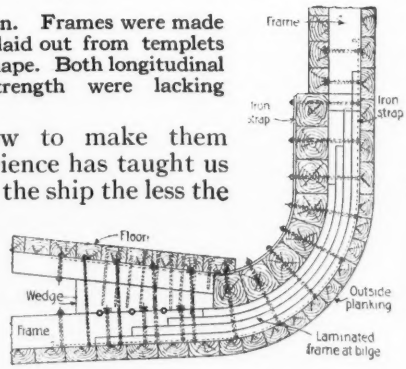


Old construction. Frames were made of short pieces laid out from templets and sawed to shape. Both longitudinal and lateral strength were lacking



New construction. Frame members are made from square mill timber. All parts are stressed to increase rigidity; ample provision for transverse and longitudinal strength

not know how to make them larger. Experience has taught us that the larger the ship the less the cost per ton carried. As long as the tonnage of the wooden ship remained small, it could not compete with the steel vessel whose tonnage capacity was many times greater.



The layered or laminated sections are notched into both straight sections of the frame

Wooden ships could not be made larger because our naval architects did not know how to make them long and still rigid enough to stand up under the load and the vibration of the engines.

The secret of Donnelly's success lies in the fact that he has applied the principles of steel-ship construction to the wooden vessel. The American Bureau of Shipping, which insures ships, after the fashion of Lloyds of England, has given the vessel an A1 rating for fifteen years.

The special characteristic of the Donnelly design is that it is made of straight pieces of stock which can be turned out at any sawmill without any tapering or special forming work. This particular characteristic is of the greatest importance at the present time. It enables

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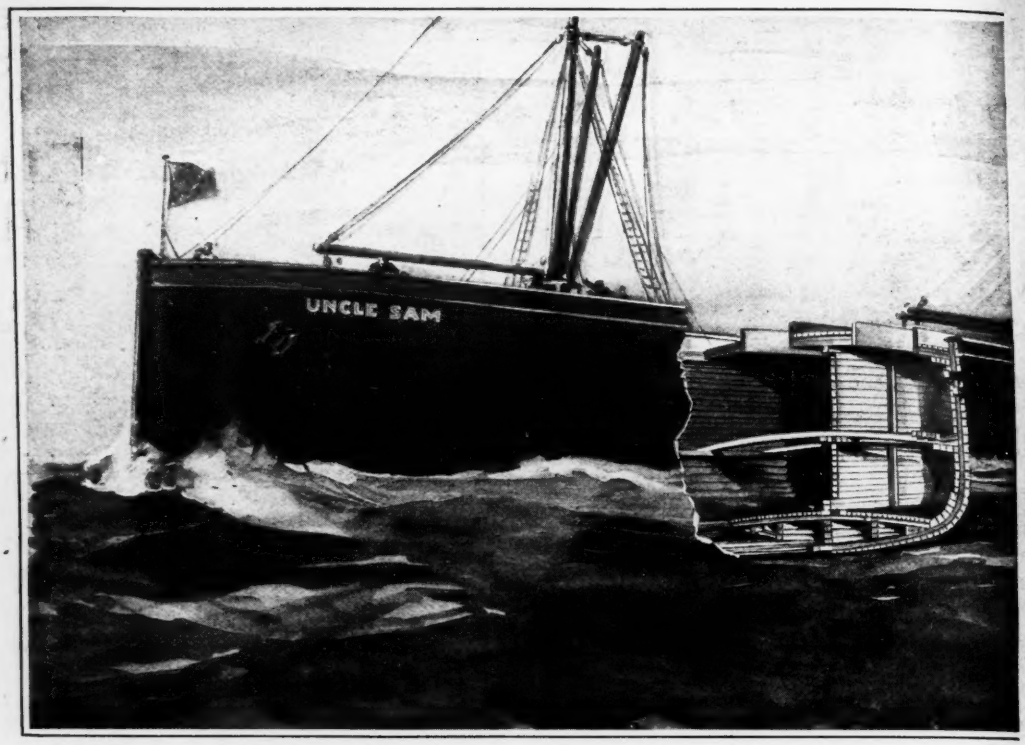
The Donnelly ship is a standardized vessel made up of parts which can be duplicated in any sawmill, shipped to the nearest shipyard and put together in much the same way as the parts of a cheap automobile



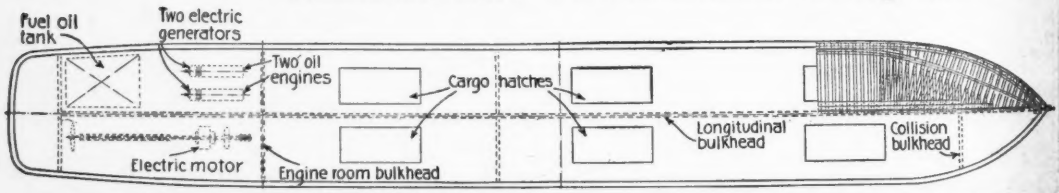
How the new wooden ship, capable of carrying five thousand five hundred tons of freight, will look when it is finished. In each ship 1,500,000 board feet of southern yellow pine made up into

hundreds of such vessels to be built simultaneously at various plants throughout the country. This will increase our tonnage rapidly—which is what must be accomplished if we are to aid in circumventing the submarine. It is understood that the recently-created Shipping Board of the United States has placed its stamp of approval on the Donnelly design and that it will supervise the construction of a large number of such vessels for use in our trans-Atlantic trade.

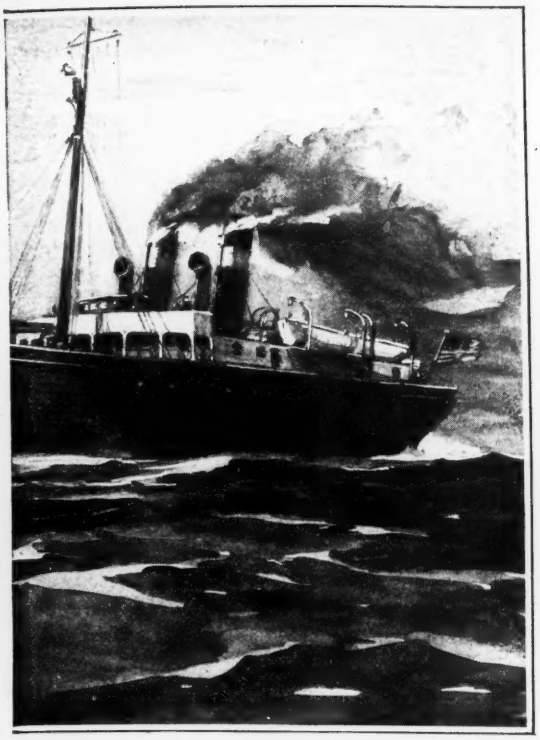
Making the Ship Rigid

In construction, the Donnelly boat differs from all previous shipbuilding practice in that it has a heavy wood longitudinal centerline bulkhead which extends clear from the stem to the rudder post. This bulkhead acts much as a girder in a railroad bridge and provides the greater part of the rigidity which has been lacking in previously-constructed wooden boats of the length of 350 feet. The bulkhead is made up of timbers laid one on top of the other, suitably tied together by vertical members.

Another particular departure from previous wooden shipbuilding practice is the manner in which the frames are made from straight mill stock with no hewn or tapered sections. Note the illustration of typical section of old construction, in which frames are shown tapered from keel to rail. As shown in the accompanying illustration of the new construction, the frames or ribs of the vessel are made up of a straight part extending across the bottom from bilge to bilge and a vertical member forming each side from the turn of the bilge to rail. The



The use of the center longitudinal bulkhead makes it necessary to have side instead of center hatches or openings through which the cargo is deposited in the hold. No cargo can be shifted once it is in the hold



readily prepared and easily assembled straight pieces of stock will replace 2,300 tons of steel

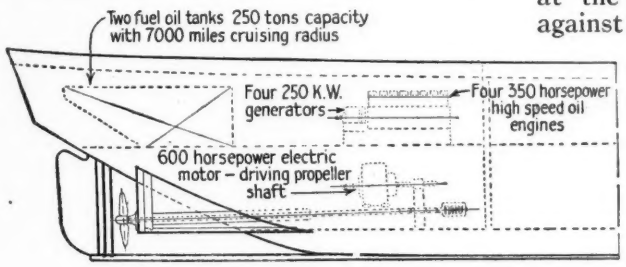
bilge turn itself is formed of a laminated section strongly connected to the previous members. All the parts are adapted to be entirely finished by machinery.

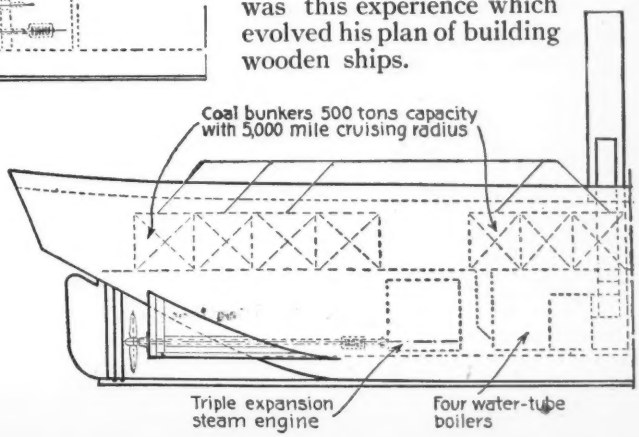
Another particular construction differing from the method previously followed is the use of what corresponds with the top plate of the double-bottom in a steel ship. This timber, of slightly less size than the frame itself, is firmly bolted to the centerline keelson at the middle and then bent downward at each end on a wedge-shaped block between it and the frame member below the turn of the bilge. The frame member is also bent upward slightly so that both pieces of timber are stressed under tension which gives a much greater degree of rigidity. Similarly the side member of the frame is stressed by being bent in slightly at the top and tied to the same frame on the other side by means of the upper deck beam, and a crosswise deck beam or stiffener is used in the hold to add rigidity to the whole frame.

Careful Loading Is Necessary

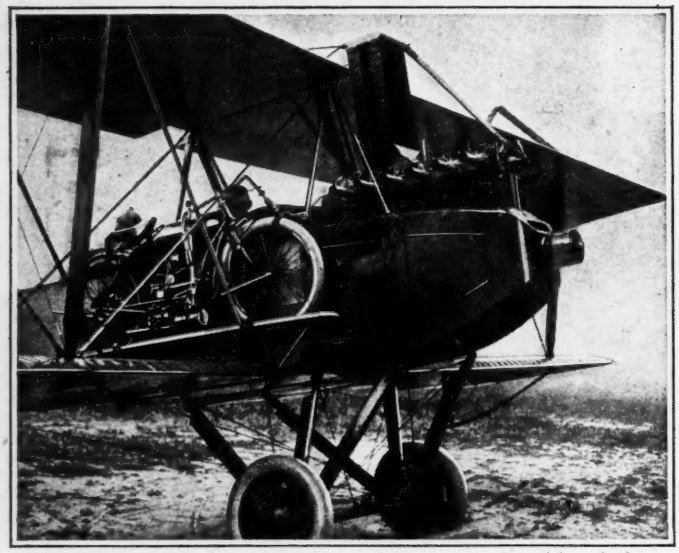
The use of the center longitudinal bulkhead makes it necessary to have side instead of center hatches or openings through which the cargo is deposited in the hold. This means that no cargo can be shifted from one side of the vessel to the other after it is once in the hold. While this necessitates careful loading of the ship to give the proper trim, it offers an additional advantage of providing a cargo space clear of beam posts or pillars.

The development of this unusual design of wood ship has been under way for more than three years, and it was a mere coincidence that it was practically completed just at the time of our declaration of war against Germany. Mr. Donnelly is a mechanical engineer who learned his trade as a pattern maker with a famous printing press builder. He became a consulting engineer on wooden drydocks in 1898. It was this experience which evolved his plan of building wooden ships.


Two fuel oil tanks 250 tons capacity with 7000 miles cruising radius
Four 250 K.W. generators
Four 350 horsepower high speed oil engines
600 horsepower electric motor – driving propeller shaft



Two types of ships have been devised, as shown in the diagrams. Two fuel oil tanks will feed four high speed oil engines, giving a cruising radius of seven thousand miles, as shown above, or a triple expansion steam engine with a coal bunker capacity of five hundred tons will give a cruising radius of five thousand miles as shown at right



The motorcycle mounted on a platform at the side of the airplane. The cyclist is a passenger. Army and navy officials believe it will increase the scouting efficiency of the fliers

Adding the Motorcycle to the Usual Airplane Equipment

A MOTORCYCLE was recently carried on a cross-country flight over Inglewood and Los Angeles, California, in a fifty-horsepower tractor biplane, on a platform between the planes and alongside the fusilage. A motorcyclist was also carried as a passenger. Despite this extra weight, the great plane got off the ground with a run of two hundred and seventy feet and climbed to an altitude of two thousand feet and later to six thousand feet, without any apparent additional effort.

When the flight was finished members of the army and navy flying corps were unanimous in their belief that the combination of airplane and motorcycle marks the beginning of a new era in military airplane equipment.

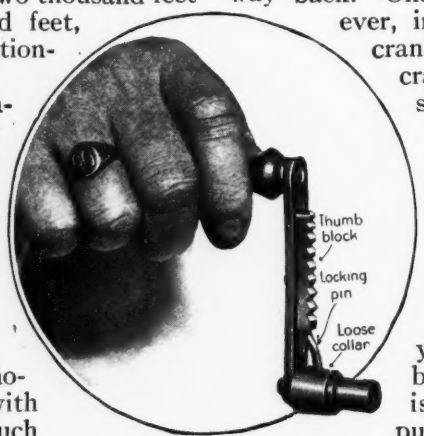
In the test flight the motorcycle was secured with straps to the airplane in such a way that it could be quickly removed. The platform that held it in position was easily constructed. At one time the airplane landed because it was short of gasoline. This the motorcyclist quickly secured.

Some Lessons Learned by the Deep-Sea Divers

EXPERIMENTS made by the British Admiralty and the United States Navy prove that deep-sea diving is feasible. It has been found that the shorter the time a diver takes in getting to the bottom the better, because the body absorbs less nitrogen. Also, the diver must have at least one and one half cubic feet of air per minute at all depths. Lacing the legs of the diver's suit increases his stability and permits him to come to an erect position with ease. It also lessens the danger of his falling or being suddenly blown to the surface.

The Fake Camera-Crank for Taking Motion Pictures

THE life of the camera-man who takes the weekly news motion pictures is not always one of glory. When Mrs. Vanderrich, for instance, asks him to take a picture of her poodle when he wants permission to take pictures of her yacht, he finds himself between two fires. Either he must waste some precious film on the dog or he must refuse and be shown the quickest way back. One wise camera-man, however, improvised a fake camera-crank for such occasions. The crank-arm fits loosely on the shaft of the film gear in the camera. When the poodle is going through his antics, the turning arm slips on the shaft, and not a foot of film is exposed although to all appearances a picture is being made.



The steel pin fits into a hole in the crank-shaft. When the pin is pulled out, the arm slips loosely on the shaft so that the motion-picture operator may go through the motions of taking a picture, to please some one, without exposing a foot of film

On coming to the yacht, however, a flat block on the crank-arm is pressed inward. This pushes a steel pin attached to the thumb block into one of the holes drilled into the crank-shaft. The crank-arm is thereby locked to the shaft, so that when the crank is turned, the film gear operates as usual.

Aiding the One-Eyed Shooter to Sight Accurately

THE middle aged man, accustomed all his life to shoot from one shoulder, can learn to shoot from the other shoulder just about as easily as he can learn to write with his left hand. But, while men who have lost the use of the right hand learn to write with the other hand because they have to, most men, having to change shoulders, stop shooting instead.

The eye directly back of the gun-rib is the guiding eye. If that is lost or injured, and the left eye put in command of the gun shot from the right shoulder, then the gun shoots neatly to the left of everything fired at. Unfortunately the eye back of the gun is the one to be injured if anything happens in the way of blow-ups or blow-backs. In sidling around the difficulty created by an injured right eye, it has been the practice to make a cross-eyed stock, with a lateral bend in it, so that the gun, held at the right shoulder, will line its barrels up before the left eye. This is clumsy and costly, and usually altogether ineffective.

Finally an American trapshooter, H. W. Cadwallader, a professional in the employ of a big cartridge company, found the obvious remedy. He evolved an off-set rib which is attached to the shotgun barrel and which is set off to the left just far enough to line up before the left or guiding eye with the gun at the other shoulder. The sole difference is that the pattern of the gun, some three feet across at effective ranges, is, say, two inches off-center.

As proof of the pudding, the inventor broke 96 per cent of 700 clay birds fired at with this off-set rib—a good record for any man.

The off-center device which makes it possible to shoot from the right shoulder at effective ranges while sighting with the left eye

A hedge of spiny cactus, sixteen feet high in some places and five feet thick, keeps out thieves and makes an attractive wall

Keeping Out Fruit Thieves with a Fence of Spiny Cactus

NEAR Glendale, Calif., is a fence which makes a very satisfactory guard for an orange and apricot grove. It is a cactus fence, grown by a rancher whose fruit was stolen by every one who passed along the road. He planted a large number of cactus shoots along his fence line. In about a year a spiny hedge had grown up to a height of three feet. It is now nearly sixteen feet in height and from five to six feet thick.

If the barbed wire fence is dreaded by every thief, what can be said of the cactus hedge? It is practically impossible to climb through it. On each of the cactus leaves are hundreds of needle-like spines. The prick of a spine may pass unnoticed at first, but an hour later inflammation and pain begin.

During the blooming season of this cactus hedge, which is between the first of May and the last of July, the fence is beautiful. The spiny buds form on the edges of the leaves, generally clustering about the tips, and soon what is known as the "cactus apple" appears.

Two dial hands indicating mileage are geared up to the two rear rollers. The cyclist who first succeeds in making the prescribed number of revolutions wins

They Make Twenty Miles an Hour but They Never Move an Inch

THE fun and exercise given by a good bicycle race need no longer be hampered by the condition of the weather. A machine has been improvised in one of New York's East side recreation centers upon which the race can proceed indoors, whatever the weather.

The machine is made up of two sets of rollers, three rollers in a set, on which the competing cyclists ride side by side. The two rear rollers of a set support the rear wheel of the bicycle. When the cyclist pedals ahead, the rear rollers are turned and a belt attached to a pulley on one of them makes the front roller of the set turn also. Both wheels of a bicycle are therefore kept revolving so that the balancing action due to motion is equivalent to that obtained on the open road.

The progress of the race is indicated by two hands that travel over a mileage dial. Each hand is geared up with a rear roller of the machine. The exact distance that each wheel has gone is also registered. Each revolution represents half a mile, and the cyclist who first finishes the prescribed number wins.

The Amount of Energy Expended in Coughing

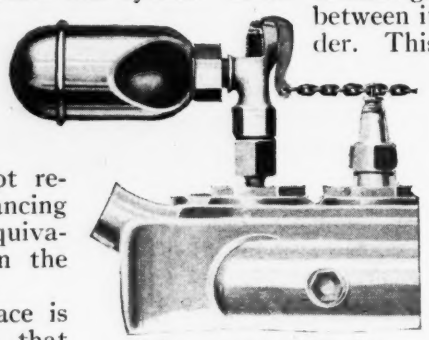
IF you cough once every fifteen minutes for ten hours you expend energy equivalent to two hundred and fifty units of heat, which is equivalent to the nourishment contained in three eggs or two glasses of milk. So says a German who has specialized on the waste of energy in coughing.

At a normal rate we expel air from the chest at the rate of four feet per second, but in violent coughing we expel it at the rate of three hundred feet a second. Thus a persistent cough not only weakens the constitution but it is a direct cause of emaciation according to the same authority. Such weighty statistics lead to a reiteration of the oft-repeated injunction, "never neglect a cough."

A Good Automobile Signal Is Accident Insurance

AN automobile warning signal recently put upon the market is a whistle that is operated by the gasoline explosions in a cylinder of the engine. At critical times the full force of the cylinder explosions operates the whistle. A powerful blast is produced which can be heard above all traffic noises.

The device consists of an air chamber into which the stream of exploding gases from the cylinder rushes to produce the blast. A small gas-tight valve is interposed between it and the top of the cylinder. This valve is very much like the exhaust poppet valves on the engine itself, except that it never opens to blow the whistle unless the driver presses the control lever for that purpose. The pressing of the lever on the driving wheel forces down the valve into the cylinder by means of the wire link connections between the two. This allows the regularly exploding gasoline to escape into the whistle instead of working against the engine piston. The explosions follow each other very rapidly.



A lever mounted on the driving wheel opens a valve and releases the exploding gas into the resonating sound chamber

A "Community" Power Plant for New York

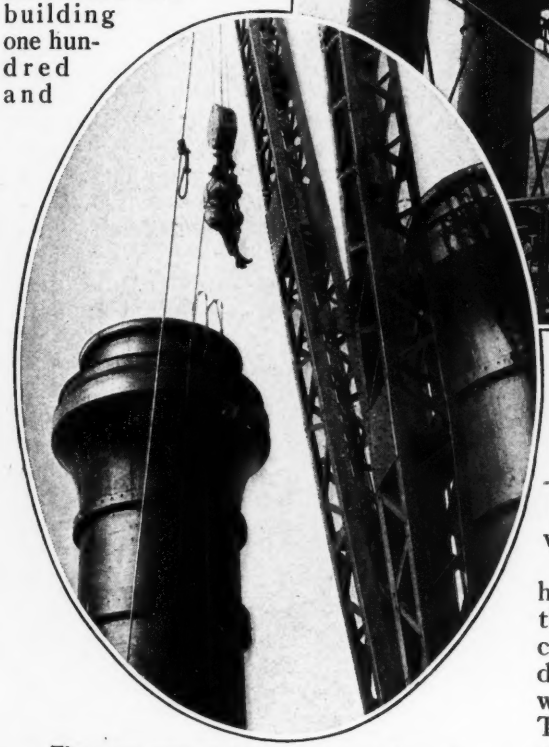
It sells heat and power to the skyscrapers of lower Manhattan

MANY of the skyscrapers now being built in New York city's financial district will have no boilers and heating plants of their own, and several old-time office buildings will discontinue using their engine rooms as soon as a giant new steam plant is put into operation. The new plant will sell steam heat and power to any building within a convenient radius. The price for such service is said to be considerably less than the cost of maintaining individual plants.

The six stacks, three on each side of the plant, are three hundred and twenty-five feet high. The boilers are located in a building one hundred and fifty feet or ten stories high. The plant represents an outlay of one and one-half million dollars. It will take nine hundred tons of coal a day to heat the water in the boilers.

Photos © Int. Film Serv.

The six giant stacks of New York's new steam power plant 300 feet high



The men were raised to their jobs and brought down again by means of steel hoists

While building the stacks New Yorkers have had the opportunity of seeing some of the most thrilling dare-devil work ever carried on by structural steel workers. On days when the wind blew a gale the workmen were often in imminent danger. They were taken up to their jobs on steel hoists. These giant stacks are right at home among the skyscrapers.

Fire Walls to Combat the Fire Menace

The principle is similar to that of the cyclone cellar or the collision bulkhead of the ocean steamer

WHEN the Asch building fire, in 1911, snuffed out the lives of one hundred and forty-five girls, the newspapers in indignation demanded adequate protection for factory workers. New and larger fire-escapes were placed on practically every building, fire drills were instituted, existing stairways were broadened, and fireproof materials of all kinds were devised over night. Today we rest easy in the knowledge that the factory fire-hazard is at last eliminated. We are only fooling ourselves.

The word "fire-escape," as applied to the usual exterior exit from a building in time of fire, is a misnomer. It should be, in most instances, "fire-trap." And our fire-drills, held with such regularity under the fire prevention laws, fail utterly under emergency conditions. This is not due to the design of the fire-escape or the weakness in the fire drill, but to inherent defects in the design of the buildings. Architects and builders generally fail to realize that the capacity of a fire-escape or stairway is limited, and that a multi-storied building, intended to be occupied by large numbers of people on each floor, must be supplied with special means for meeting the exigencies of a rapid egress.

Although the fire-drill has been made compulsory in several States, it is the dread of most factory owners. In some New York city shops the workers absolutely refuse to go out on fire escapes that are from ten to thirty stories above the street. When a fire drill interrupts the day's work, the day is practically lost, because some girls among the workers become hysterical and others take several hours to get back into the spirit of their work. Of course the fire drills in the public schools have reached a high point of efficiency, but according to one prominent investigator who studied the fire-hazard question, there was not a single concern he visited which had developed a scheme of rapid dismissal similar to the school-drill.

Fire in a typical New York loft building. In spite of fire laws and drills the fire escapes are inadequate, the stairways jammed and the elevators stopped

Mr. H. F. J. Porter, an engineer and advisory expert on fire prevention, who was one of the first to institute fire drills in factories to facilitate the escape of the occupants in case of fire, early saw the shortcomings of the fire drill and the inadequacy of the fire escape. In casting about for some other method of escape from fire he has pressed into service the most natural and available means at his disposal: a wall of substantial and fireproof construction, extending from cellar to roof, with doorways in it on each floor.

In case of fire on one side of the wall, the people on that side simply pass through the doorways, close the fireproof doors and are perfect-

ly safe from the flames whose progress in that direction is arrested. The principle involved is similar to that of the cyclone cellar of the western home, or the collision bulkhead of the ocean steamer. The fire wall develops a "bi-sectional building," offering a horizontal instead of a vertical escape, making the fire drill unnecessary.

There is nothing new about the fire wall. It already exists in buildings everywhere, in one form or another, and its value as a fire stop to protect property has long been known. Its availability as a fire-escape has not, however, been recognized, and it is this feature which Mr. Porter has advanced as affording the only means of safe escape from fire to the occupants of crowded floors. He has shown that the idea is as applicable to department stores, schools, theaters, hotels, hospitals and residences as to factories.

Besides being a safe and effective means of protecting life, the fire wall is equally desirable from the standpoint of preventing large property losses, and for that reason it is advocated by the insurance and underwriting interests. In one hundred and fifty-nine buildings, fire walls were found in thirty-five, and where used and understood, engendered a feeling of security and safety. Mr. Porter recommends that fire walls be compulsory in every future factory building over seven stories or eighty-five feet in height which is occupied by more than fifty persons above the first floor.

Fire in a loft building equipped with the fire wall. The occupants pass through the doors of the fire wall and are immediately out of reach of the flames

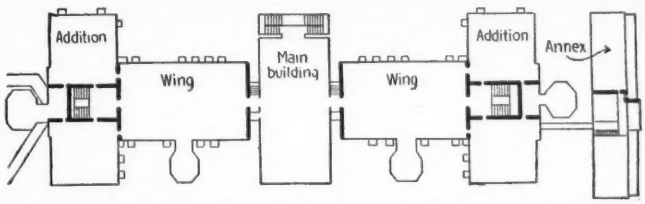


Diagram showing how fire walls are utilized in New York city hospital buildings. Heavy lines indicate the fire walls

In no direction is the necessity for the sectional building greater than in the hospital field. It seems incredible, but it is nevertheless true, that hospitals, asylums, and similar institutions housing bed patients, cripples, the blind, the insane, and infants, have too few attendants to help them. Thus, in case of fire, these helpless inmates must inevitably perish. In the sectionalized hospital, the attendants are called from wherever they may be to the endangered section. Here they wheel the bed patients in their beds and assist the others the short distance necessary to the adjoining sections where, with a minimum of disturbance and of time, they are rendered perfectly safe. Mr. Porter has introduced this system in all the hospital and institutional buildings of the Department of Public Charities of New York city, and in others elsewhere. He has offered his services free through the Mayor's Committee on Defense of New York city, to plan and supervise the sectionalizing of any hospital which tenders its facilities to the nation in the present crisis.

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With their hands and elbows on the piano the deaf mutes "hear" the music through vibrations

How Deaf Mutes Feel Music Through Their Lungs, Feet, and Heads

DEAF mutes love music. It thrills them. The accompanying illustration shows four deaf mutes receiving musical vibrations by placing their hands and elbows on the piano while the teacher plays it. The vibrations not only give sensations which enliven the body but they actually stimulate them. The parts most sensitive to vibrations are the chest, head, lungs and feet. "An exciting feeling comes up through the floor," is the way one deaf boy describes it. "Without music I would be lonesome," wrote a little Italian deaf-mute. "It gives me a strong shock through the feet to the head," stated another. Others, when asked to explain their sensations, said: "I feel it in my temples and in my legs," "I feel it through my whole body," and "Ifeel it in my chest and lungs."

According to teachers of deaf-mutes, musical instruction is more important as an educational factor for the deaf child than it is for the hearing. Of course it is doubtful if the totally deaf child can learn to distinguish pitch or tone, and discord from harmony, in the accepted sense. But there is no question that they feel music and that it stirs their emotions. In the New York Institution for the Deaf, eye rhythm, ear rhythm, body rhythm and motion rhythm are all utilized.

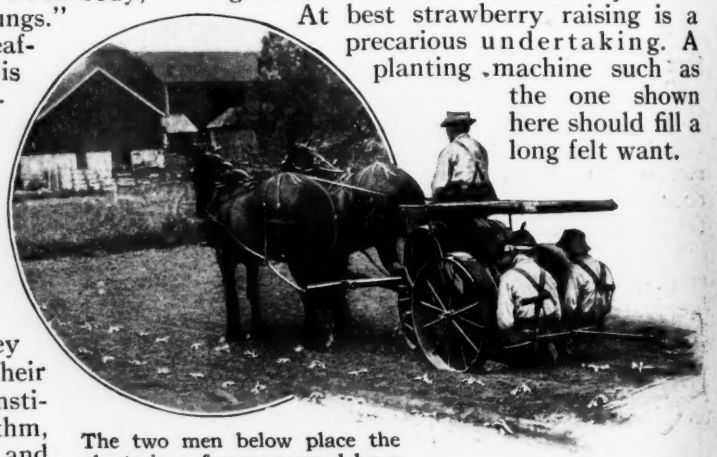
Planting Strawberries with a New Time-Saving Machine

STRAWBERRY growers will find that a machine which sets out the plants better than it can be done by hand is a means of saving a great deal of back-breaking work. As three men and a team of horses are able to set out three acres a day with the machine, it also means that the plants may be put into the ground when weather and soil conditions are the most favorable.

One of the men drives the team, while the other two place the plants in the ground in a furrow opened up by a shoe of the kind used on corn-planters. An automatic trip connected with the wheels opens a valve, so that water escapes from a barrel and drenches the roots of the plants; two inclined wheels then press the soil firmly about the roots and even cover the wet soil with a layer of dry dirt which prevents caking. Spaces between plants may be regulated to suit the grower. The frequency with which the water is allowed to escape can be finely adjusted by means of a lever.

After the plants are set out, it is necessary for a man to go over the work, here and there removing excess dirt or placing the roots deeper in the ground. The machine works best in a good seed bed, but has been used with success in sod ground. One grower of long experience succeeded in getting an average of ninety-six per cent of his plants to grow—a larger percentage by far than he was ever able to get when the work was done by hand.

At best strawberry raising is a precarious undertaking. A planting machine such as the one shown here should fill a long felt want.



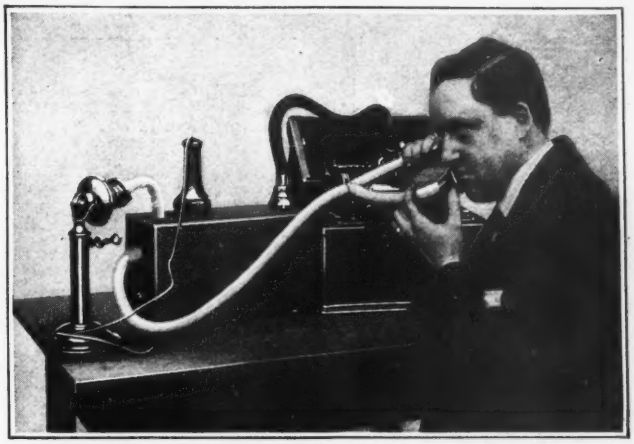
The two men below place the plants in a furrow opened by a shoe. Water is automatically fed

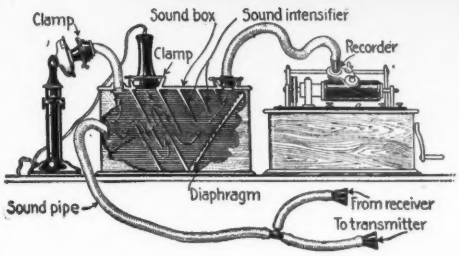
Attaching the Phonograph to the Telephone—the Latest Efficiency Device

A MISTAKE in that order? Was it taken over the telephone? And was there a dictaphone record of it? If so the error is not likely to be chargeable to the office, for there in the complainant's own voice is the record of what he said over the telephone. That's the newest idea.

All this is realized by means of an invention patented by Greenhow Johnston, of Richmond, Va., which transfers conversations from the telephone to the phonograph.

The transference of the sound waves is made through a small box which contains a number of reeds inside. This box is the keystone in the invention, for it amplifies the telephone sounds so that they will make an intelligible record on the phonograph. The ordinary sounds from the telephone receiver are too weak and too befogged to produce a clear record when led to the phonograph directly. But when these same sounds are led first through the box, the reeds take up their vibrations and add strength to their tone. The receiver and the transmitter are both connected with the amplifying box by tubes. The phonograph is also connected with the box by a tube.





Transferring conversation from the telephone to the phonograph

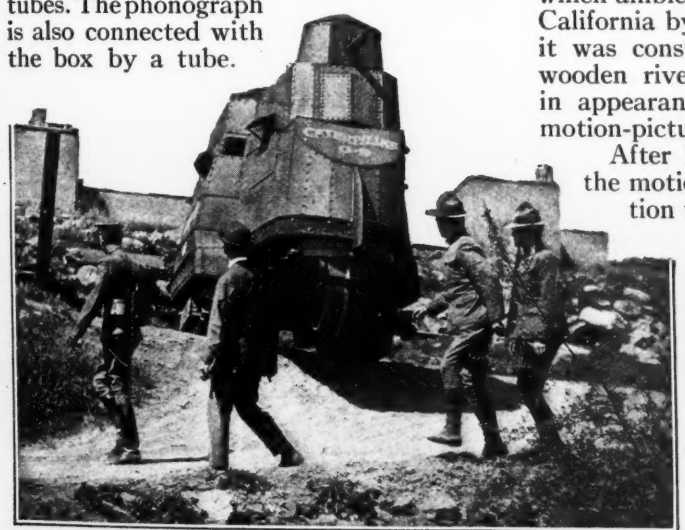
At left: How the telephone sounds are amplified to make a record

The device can take the conversation of either or both persons talking, or, if not needed, it can be easily disconnected from the telephone. Connection can be made with any telephone or phonograph.

A Wooden Tank Shows Itself Off Before Army Officers in California

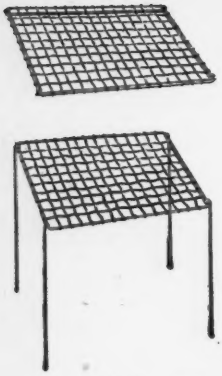
AN armored tractor car of the tank variety which disclaims any relationship to the members of the original family which ambled across No Man's Land, took California by surprise recently. Although it was constructed of light lumber with wooden rivets it was formidable enough in appearance to furnish the thrill for a motion-picture battle.

After it had served the purpose of the motion-picture people a demonstration test was held before a board of the United States army officers at Los Angeles. The pseudo tank climbed hills and worked its way over sand dunes to the edification of the army men. The formidable-looking gun which peeps out of the front turret is of wood and is as harmless as a pea-shooter. One noteworthy innovation is the wire cutting blade carried in front directly over the wheel.

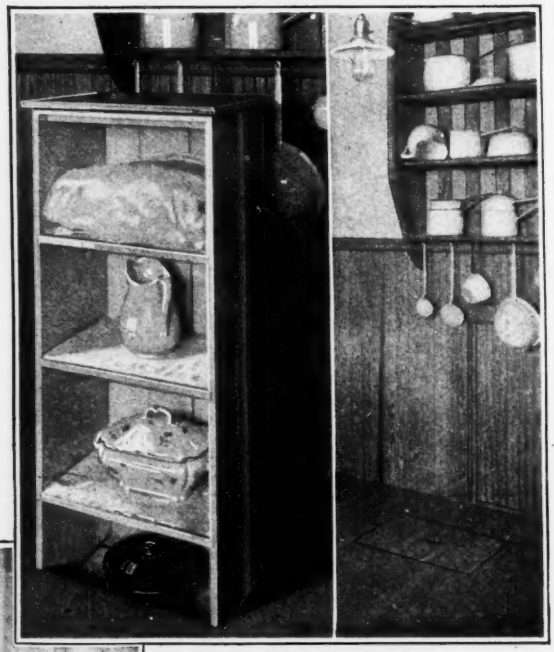


Army officers watching the maneuvers of the wooden tank. The wire-cutting blade over the front wheel is an innovation

Housekeeping Made Easy



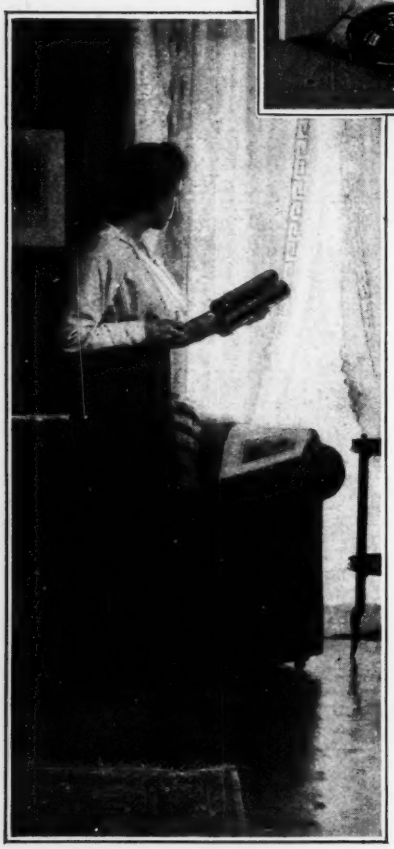
A grid for use over the outdoor fire. It may be used either with or without the legs



A step-saving problem was solved by this dumbwaiter. A hole was cut in the floor through which the dumbwaiter could be lowered into the cellar in order to keep food supplies in a cool place. The top of the dumbwaiter fits over the hole like a trap-door as shown at right above

A simple device for removing the pit from a peach without crushing the fruit or staining the hand with juice

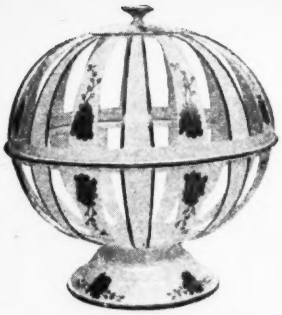
A metal strainer is attached to the side of the preserving kettle to hold the spoon in place



The latest device for keeping out flies is a sprayer filled with a solution that is deadly to flies, but will not injure the finest fabrics such as are used for curtains. The smell of it, though faint, will keep away all insects

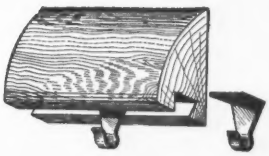
An old tooth-paste tube unfolded, thoroughly cleaned and polished and rolled again over a round object, makes a serviceable icing-gun. Any shaped outlet hole can be easily made in the top

Housekeeping Made Easy

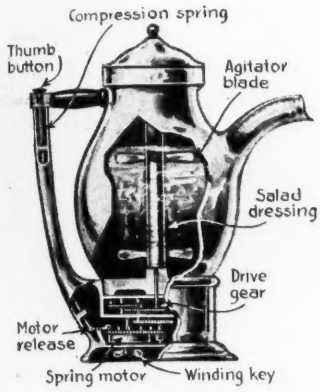


A novel orange bowl made in the form of a sphere. It is nine inches in diameter and finished in white with colored flowers

A self-server consisting of a small disk or table so constructed that it revolves on a short pedestal. It stands in the center of a table, within convenient reach



A dovetail groove cut in the underside of any picture rail to take a specially formed hook for hanging pictures without marring or disfiguring the molding in the slightest degree



A salad dressing container in which a rotating part with wings is driven by hand or motor power to mix the ingredients. It resembles a coffee pot

With the advent of the electrical heating teapot almost every kind of modern cooking utensil is self-contained

Flies naturally collect at the upper part of a door and enter there when the door is opened. With the two-part screen door children can pass out and in without giving the flies the slightest chance to enter the house

The Wonders of Coal Tar

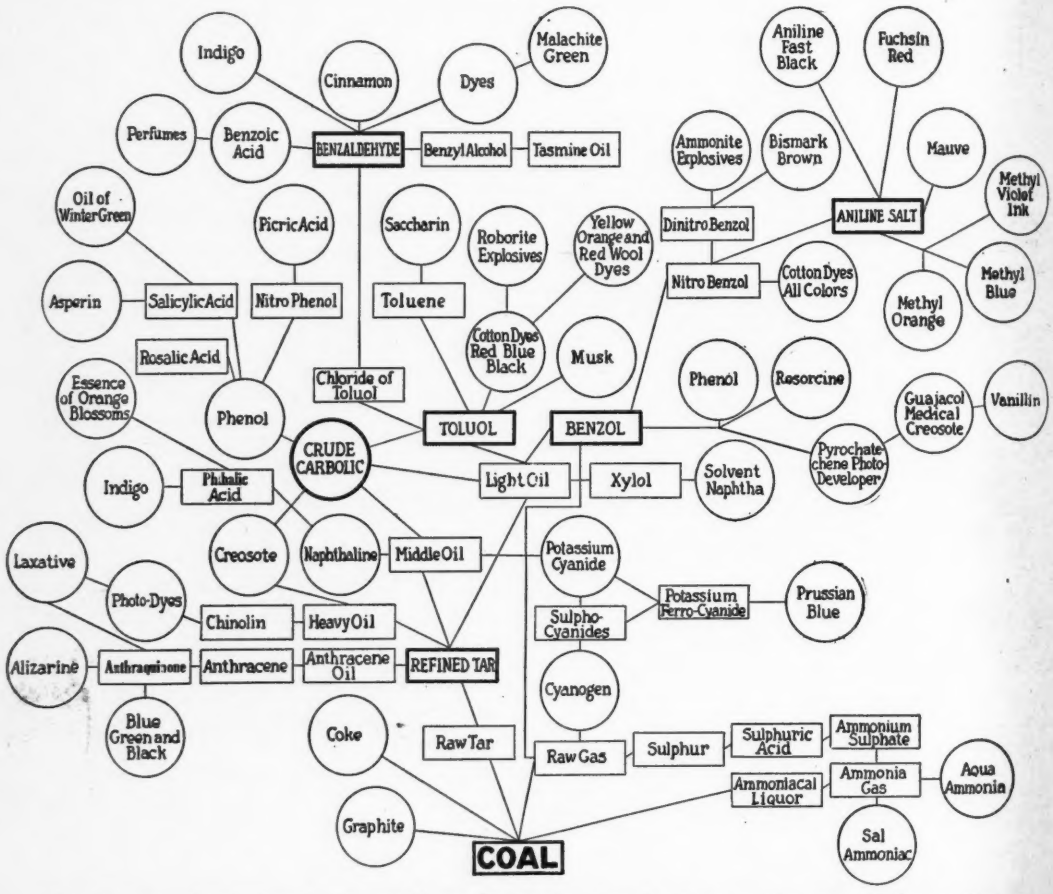
No branch of industrial chemistry yields more widely applicable and varying products than the distillation of coal

By George M. Oaks

IF you have ever tried to run a furnace you know that coal gives off gas when heated. Yes, and you probably know that most of our illuminating gas comes from coal in that way. In by-product coke ovens the coal is heated in closed vessels so that the coal is distilled and not burnt up. But did you realize that this is the basic operation leading to hundreds of common, everyday products: tar, coke, lampblack, creosote, carbolic acid, naphtha, sal-ammoniac, ammonia, varnish, photographic materials, explosives, drugs, mineral vanilla, dyes and many others?

Coal, when heated, is chemically dismembered to form several new substances which can be recombined or united with other substances to form new products. A toy house, made out of a child's building blocks, can be taken apart and a new house built, either out of the same blocks or by adding others. This process, it should be borne in mind, is a mechanical one, and only serves to illustrate in a simple way the distillation of coal, which is a chemical process.

Synthesis, or the process of building up new products from simpler ones, is best illustrated in making dyes. There are now so many shades of the same color that we



Coal is a precious mineral. Its value can be better appreciated by noting some of the products such as dyes, explosives, drugs and perfumes, obtained directly or indirectly from its distillation

have no little trouble in trying to match colors, whether silks or house paints; not because the chemist cannot make the same shade twice. Indeed the synthesis of dyes is like the multiplication table for reliability. It always gives the same result.

The Modern Chemist Experiments on Paper

Instead of messing around in a laboratory with a dozen or more retorts, a lot of stains and a dirty, smudgy atmosphere, the chemist of today simply sits at his desk, far away from the choking acid fumes of his laboratory, and figures out on a sheet of paper the colors he wishes to produce. He knows that certain ingredients will yield certain results and proceeds to combine them in such a way as to build up what he wants before he ever carries out the actual chemical reactions theoretically worked out.

Such a procedure forms a remarkable contrast with the laborious experimenting which led to the discovery of mauve, the first coal tar dye, by Perkin, in 1856. He was an enthusiastic young English chemist who took a notion to build up quinine from simpler chemicals. He chose a college Easter vacation for his research work and labored day and night to obtain his ends. But quinine did not result; only a dingy dark precipitate was formed. Perkin was disgusted. The stuff would not even dissolve in water. He tried alcohol. To his astonishment and delight, a most beautiful violet color was produced which dyed silk a magnificent purple.

Though only eighteen years of age, Perkin was old enough to realize the vast commercial possibilities of this discovery. Within three years the women of England had lost all sense of reason over the new color. *Punch* made the following comment:

"Lovely woman is just now afflicted with a malady which apparently is spreading to so serious an extent that it is high time to consider by what means it may be checked. . . . One of the first symptoms by which the malady declares itself consists in the eruption of a measly rash of ribbons about the head and neck of the person who has caught it. The eruption, which is of a *mauve* color, soon spreads, until, in many cases, the sufferer becomes completely covered with it."

Hair fastened with glue from all day suckers
Cheek colored with poisonous dye from candy
Waist dyed with coloring matter from lollypops
Skirt dyed another color also from lollypops
A poisonous lollypop
Dyed vivid green from a cent's worth of lollypops
Plated with copper from can of peas
Shoe lined with shellac from peach pits
with lampblack from licorice candy

Professor D. R. Hodgdon dyed this doll's brightly-colored clothes with coal tar coloring-matter which he obtained from cheap, poisonous candy

In speaking of finished dyes, we have jumped from coal clean over the thousand and one intervening processes, to the usable product. After coal is first split up, the next most important way station on our trip from coal to the outskirts of the whole industry, is coal tar.

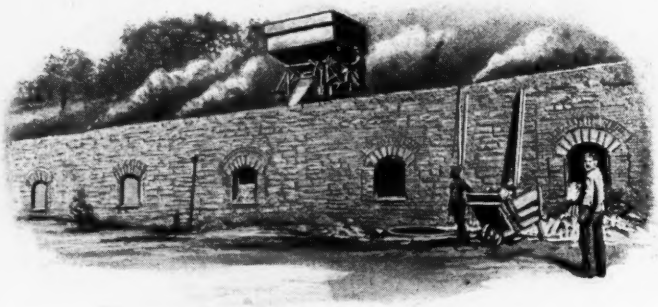
Coal tar is the most disagreeable, foul-smelling, black sticky liquid you ever saw.

When gas is distilled coal tar condenses in the pipes. For years every gas works had to contend with it as an extremely bothersome by-product. It was worse than waste, for vegetation died wherever it was spilled; streams were polluted if it was allowed to drain into them. It is a combination of liquid and solid substances consisting mainly of hydrocarbons, which are complex compounds of hydrogen and carbon. The separation of these constituents into such products as paraffin, naphtha, benzene, cyanogen and the like, is now an industry netting millions of dollars annually. Coal tar is now practically distilled in order to obtain these products.

Fractional distillation is the gradual raising of the temperature, driving off the

more volatile gases first and the heavy ones afterward. This treatment of coal tar is combined with alternate treatment by certain chemicals, commonly referred to as reagents. These reagents consist of dilute caustic soda, dilute acid and concentrated sulphuric acid.

When distilled up to 252 deg. Fahr., benzene, more frequently referred to as benzol, is obtained. It is the first to pass over. By further distillation, up to 306 deg. Fahr., solvent and burning-naphtha are also driven out. Still further heating from 414 deg. to 486 deg. Fahr., results in the formation of creosote and other oils, referred to as the heavy oils.



A beehive coke oven. The coal is admitted at the top and the coke removed through the side openings. By this crude method, the tar and ammonia are entirely wasted, passing off into the air

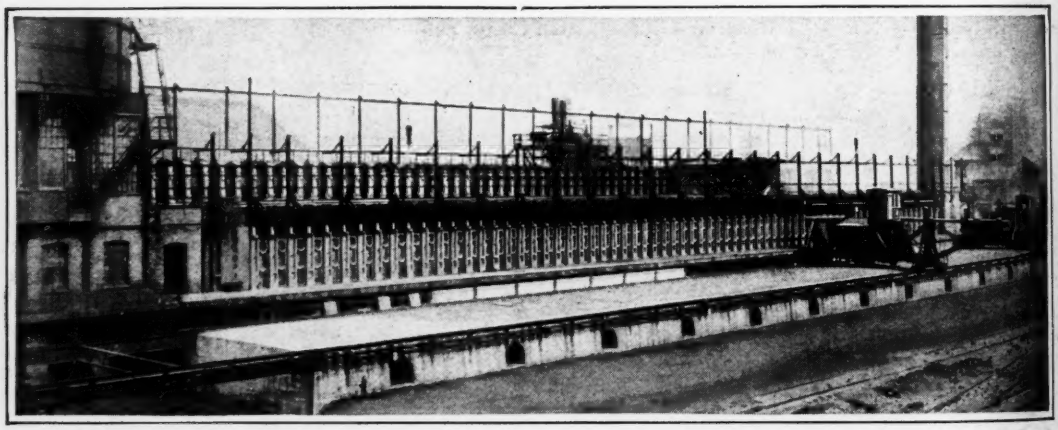
Beyond these are obtained anthracene oil and anthracene, both used in making dyes. Other products are lampblack, used in making printer's ink; pitch, employed for roofing, road-building, water-proofing; and coke, used instead of coal for obtaining intense heat without smoke, especially in blast furnaces. In 1916, 54,200,000 tons of coke were manufactured in the United States.

Benzol Obtained from Gas or Tar

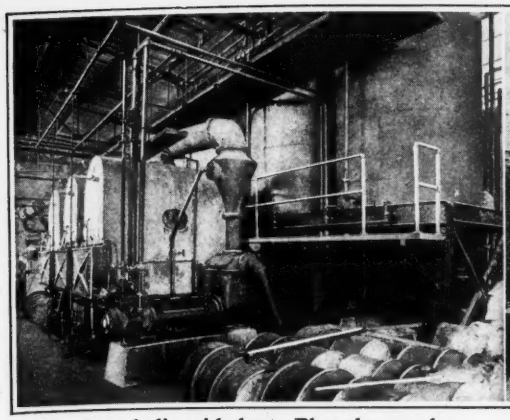
In the case of coke oven gas, benzene (or benzol) is obtained by a direct recovery method. The recovery of benzol is limited almost entirely to the coke oven plant and to the tar distiller. The chart on page 874 shows how benzol can be obtained directly from raw gas or indirectly from the raw tar.

During the distillation of tar the so-called light, middle and heavy oils which come off give us the first nine dye "crudes," such as benzol, toluol, xylol, naphthalene. By addition and subtraction of various chemicals, and by certain chemical changes, these crudes make up the 300 dye "intermediates," such as phenol, aniline, cresol, etc. These, by further addition and subtraction, make the 1200 different coal tar derivative dyes.

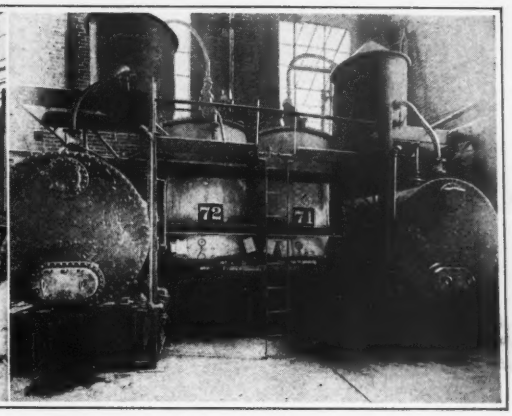
These colors range from black up through the rainbow colors and other shades, such as the browns and grays. In fact, to tell the difference between two similar shades is like splitting hairs. In the chart, page 879, I have shown only the production of basic reds.



A battery of by-product ovens. Observe two trams, the upper one for depositing coal in the ovens and the lower one for ramming the coke out on the farther side. The ovens are sealed with a clay-packed lid. Half the gas formed is consumed in heating the coal. The remainder, as well as the tar and ammonia, is conducted away through pipe lines to the receiving tanks



Crude carbolic acid plant. Phenols, cresols, xylols are washed with caustic soda. The phenol is freed from soda with acids



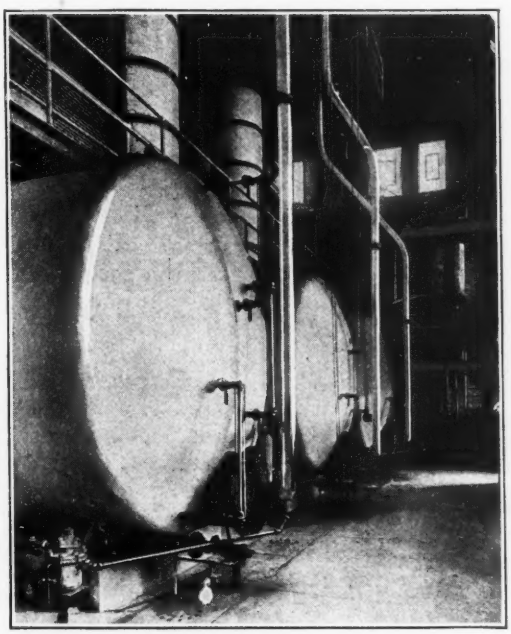
From the refining stills, 71 and 72, the phenol passes into the cooling tanks above, and then into the large receivers below

Coal tar dyes lend themselves so easily to coloring all substances capable of being colored that they are only too frequently abused. The illustration on page 875 shows a doll made by Prof. D. R. Hodgdon, who wished to call attention to the deleterious use of aniline dyes in candy. Miss F. P. Sweets (Fraudulent Poisonous) contains poisons extracted from cheap confections, such as lollypops and all-day-suckers. The glue which holds her hair on, the brilliant pink dress and green stockings, the copper on her knife blade, and the lampblack on her shiny shoes are all right in their place, but surely that place is not a child's stomach.

Although an Englishman discovered the first coal tar dye, the German and not the English developed his discovery commercially. They succeeded so well that they destroyed the natural dye industry. Then India suddenly found that her indigo plantations were ruined. So cochineal, and mineral dyes, like Prussian blue and chrome yellow, have been rapidly giving place to the modern synthetic dyes, now prepared from coal tar.

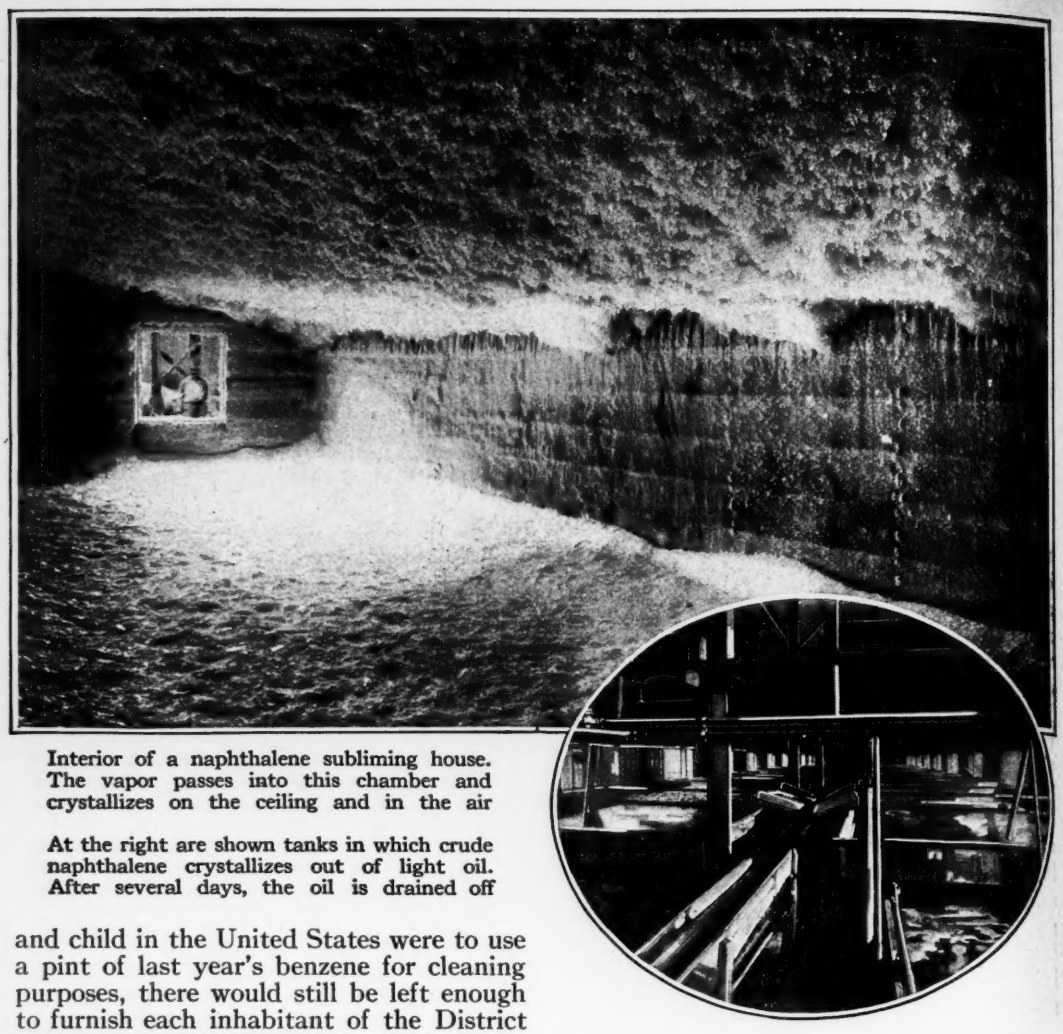
An average tar yields seventy per cent of pitch and only six per cent of materials useful in making dyes. In the United States, ninety per cent of the tar goes to make better roads and better roofs, and also for the manufacture of creosote oil, naphthalene and other profitable products.

After leaving coal tar, the next station is benzol. Benzol is an extremely inflammable, colorless liquid obtained as previously stated, by the destructive distillation of coal tar. It is the basic product for the manufacture of aniline colors and also cheap varnishes. It is used for many other purposes, chief among them being the manufacture of explosives.



Huge benzol stills. The apparatus at the right is an agitator in which benzol is washed with sulphuric acid before entering the stills

Before the European war, the normal production of benzol in the United States was approximately 3,000,000 gallons annually. Since the war, many steel companies, and other similar industries, which could recover benzol from their other operations, have been doing so. Result—in 1916, upwards of 15,000,000 gallons were produced. If every man, woman



Interior of a naphthalene subliming house. The vapor passes into this chamber and crystallizes on the ceiling and in the air

At the right are shown tanks in which crude naphthalene crystallizes out of light oil. After several days, the oil is drained off

and child in the United States were to use a pint of last year's benzene for cleaning purposes, there would still be left enough to furnish each inhabitant of the District of Columbia with another pint. This enormous increase has been more than offset by the simultaneous increase in the demand for explosives.

Ancient signs and wonders pale when we consider the stupendous importance of coal tar. The indigo annually consumed in the United States would buy army rifles for 62,500 United States troops. The sulphur black used in one year weighs as much as two ordinary passenger trains of ten cars each, including the locomotives. The technical name for sulphur black is di-nitro-oxy-di-phenyl-amine. Think of the millions of pairs of ordinary black socks dyed that color!

More than twice as much naphthalene is being used as before the war. It has largely taken the place of camphor. At present it is being used, not so much for exterminating moths, as for killing men, since this important coal tar "intermediate" is employed largely in the manufacture of explosives. In 1916, 3,500 tons were produced in the United States.

It is estimated that in 1917 over 300,000,000 gallons of tar, or 3,000,000,000 pounds will be used. Of this, 1,800,000,000 pounds will become pitch, leaving 1,200,000,000 pounds for dyes, medicines, disinfectants, explosives and other similar products.

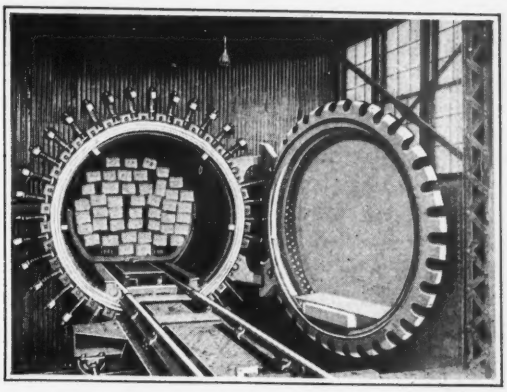
Before the war, aniline oil, which is derived from benzol, and which is so important in making aniline colors, was not manufactured to any extent in the United States. It was furnished almost exclusively by Germany and England, the prices and conditions being beyond our control. In 1914, imports dropped suddenly. The demand for aniline oil became acute. Even yet this precious chemical is not turned out

in sufficient quantity to meet our demand entirely, though it will be if the present increase in production continues.

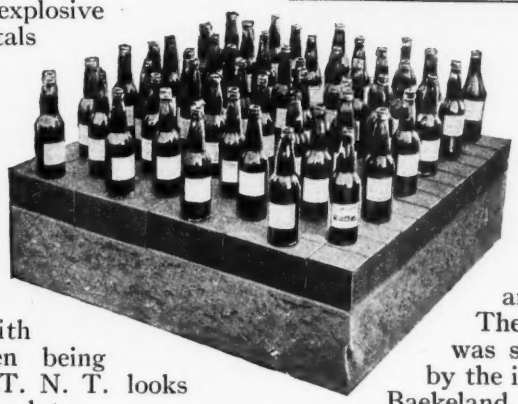
Aniline Dyes Valuable in Bacteriology

Aside from the common uses of aniline dyes may be noted the vast requirements of bacteriology. This science has made incredible progress since the staining of microscopic preparations with aniline dyes has enabled scientists to distinguish and recognize germs. Thus typhoid, cholera, tuberculosis, and other baffling diseases have been defined and studied.

The most familiar explosive in the minds of mortals today is T. N. T. (tri-nitro-toluene) —a coal tar product. It is an oil belonging to the benzol group, and obtained by the distillation of primary oil. It is the result of combining nitric acid with pure toluene. When being poured into shells, T. N. T. looks like thick, syrupy chocolate.



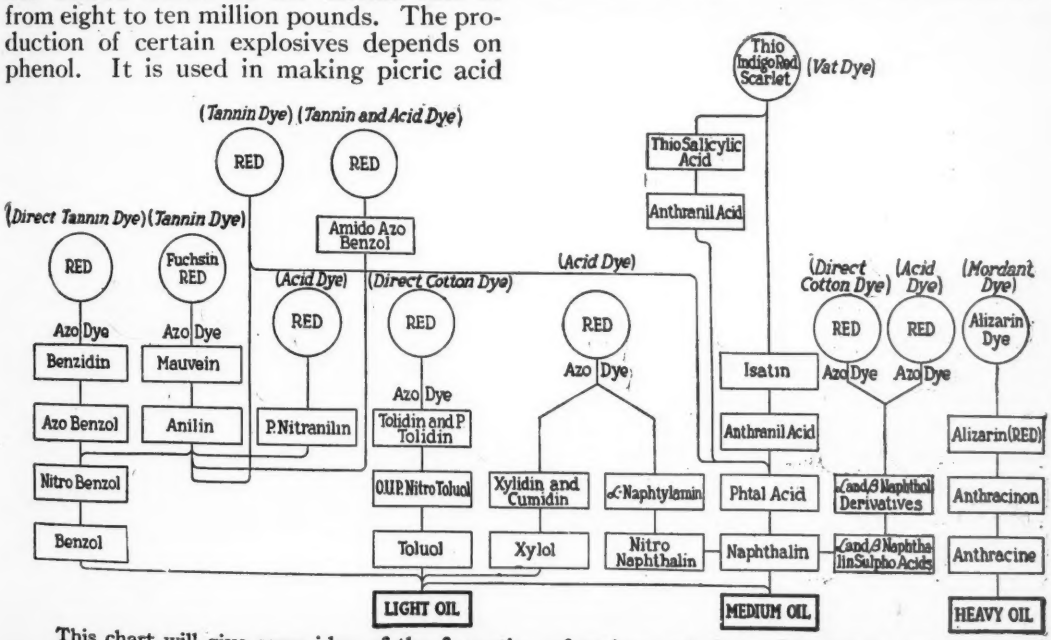
Whole trainloads of wood to be creosoted are run into long cylinders and allowed to soak for several days



A square yard of wood block pavement contains 45.36 pints of creosote oil

Carbolic Acid Has Many Uses

Phenol (carbolic acid) is consumed in the United States at the annual rate of from eight to ten million pounds. The production of certain explosives depends on phenol. It is used in making picric acid and also aniline colors. The great value of phenol was still further heightened by the invention, by Dr. L. H. Baekeland, of a peculiar resinous substance which can be used in place of hard rubber. It seems like a magician's trick to combine two such strong-smelling liquids as carbolic acid and formalin to



This chart will give some idea of the formation of various red dyes. It may be noted that most of these colors start from light oil; also that certain shades may be formed in two ways

form a solid, transparent, amber-like substance, odorless, heat-resisting, a non-conductor of electricity, impervious to most acids, oils and steam, and insoluble in all known solvents.

This substance is used for insulating, especially in automobile ignition work, since it does not burn or soften when heated. It also makes beautiful parasol handles, fountain pens, buttons and numerous other useful articles. The chemical name for this jack-of-all-trades is oxy-benzyl-methylen-glycol-anhydrite.

Another substance which traces its origin back to the shining lump of coal is ammonia, important in chemical manufacture, in refrigeration, as a source of nitric acid and in fertilizers. Inks of all sorts are derived indirectly from coal tar. Among them are printing inks, ranging from cheap newspaper black, made from lampblack, to thick heavy paste used in copperplate printing. Colored printing and writing fluids as well as typewriter ribbons and copying inks are also made.

Vanillin, which has the flavor of the vanilla bean, is obtained from benzene. Creosote is used as a wood preservative and medicine. Benzaldehyde is the base of many exquisite perfumes. Benzoic acid is used as a food preservative and saccharin is a substitute for sugar, used by diabetic patients. Phenacetine is a drug used in controlling fever, and salicylic acid becomes asperin, used for all sorts of aches and pains.

Artificial Sunlight for Bald Heads

WHAT causes sunburn? Not the heat of the sun, but the light alone. It is not the light that you can see but the light that you cannot see—what the physicist calls ultra-violet radiation. Just as there are sounds that we cannot hear, so there is light that we cannot see. If our eyes were only differently constituted we might see ultra-violet radiations.

These ultra-violet radiations have very remarkable curative properties. They kill germs, and they penetrate the skin sufficiently to set up a wonderfully stimulating action. Hence, special lamps have been constructed which radiate ultra-violet light and which are used for the treatment of skin diseases in particular.

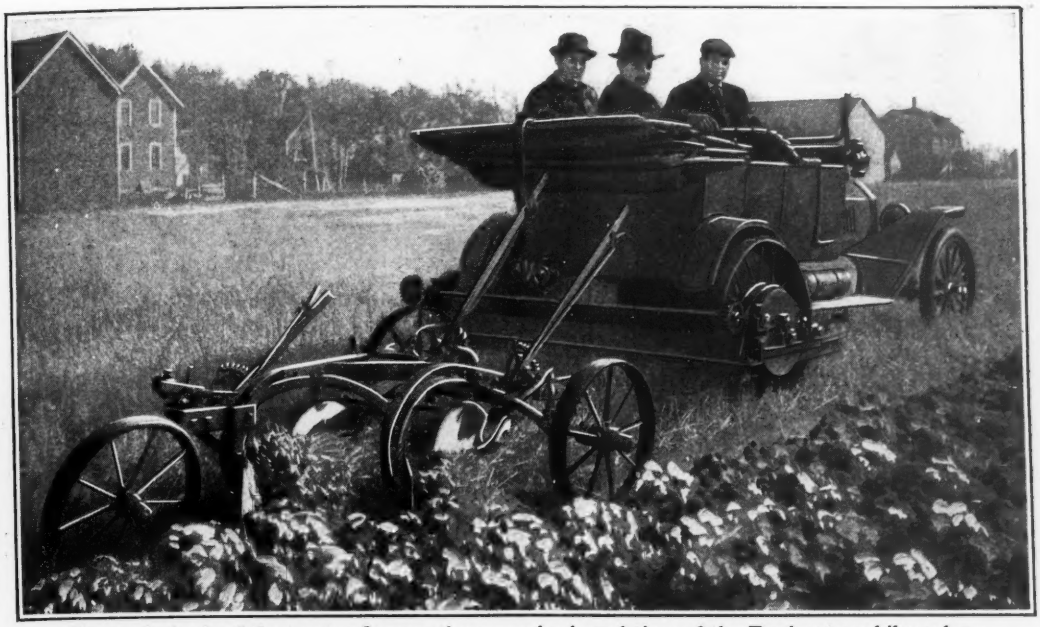
Dr. Ludwig Oulmann, the New York skin specialist, treating a case of baldness with ultra-violet radiations. The lamp used may be regarded as a very intense miniature sun. Twenty minutes' exposure sets up a stimulating action which induces the hair to grow

Since baldness is a skin disease, it follows that physicians have been treating it with ultra-violet radiations. The results are often astonishing. Many a head as free from hair as an egg has been exposed for twenty minutes, at intervals of three weeks, with the result that in about two months down begins to sprout. There are cases enough to show that ultra-violet radiations restore prematurely gray hair to its natural color.

A bald head exposed to ultra-violet radiations appears in twenty-four to forty-eight hours as if it has been sunburned. In reality, it has—by an artificial sun of great intensity. The skin peels and tans. Nature is encouraged, as it were, to remove the dead matter and to create new hair.

Ploughing the Farm by Automobile

The latest tractor attachment converts the Ford pleasure car into a motor-operated farm implement with push-button rapidity



The steel wheels of the tractor fit over the rear wheels and tires of the Ford automobile and are locked in place. This gives sufficient stability to pull any light agricultural implement

DIFFERING from all other forms of tractor attachments to be applied to the Ford car for cultivating small farms, that shown in the accompanying illustrations does not require the removal of a single part of the original passenger car. The entire apparatus can be attached in a few minutes and detached in less time.

The great advantage of a device of this kind is that its cost is reasonable enough to bring it within the reach of the small farmer who has need of a tractor for only a small part of each year. Besides, it enables him to use his passenger car for either business or pleasure and without any long delays incident to the removal of wheels and various parts of the driving mechanism, as in most devices of this kind.

The device is made in two halves, which are simply slipped over the rear end of the chassis, wheels and all, and then bolted together at front and rear. This gives sufficient stability to pull farm wagons as trailers, a plow, harrow, cutter, binder or in fact any form of light agricultural implement.

The two steel wheels of the device have grip treads, each wheel carried on a short stub axle driven by chains and sprockets from a notched axle into which lugs placed on the hub of the Ford wheel are slipped. The tractor wheels are supported on two side frames bent inward at the front and joined to a U-bolt on the Ford front axle and tied together at the rear by a crosswise bar aft of the regular Ford touring or roadster body. The two halves of the device are slipped into place from the sides and locked into position.

To restore the car to its original appearance and service it is only necessary to loosen the bolts and remove the steel wheels.

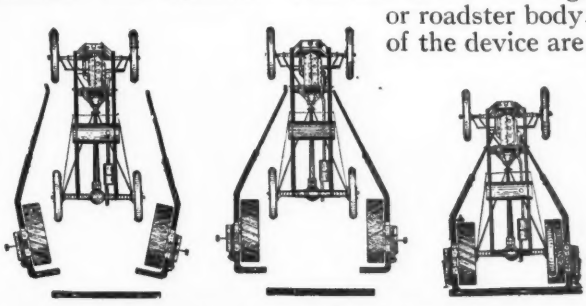
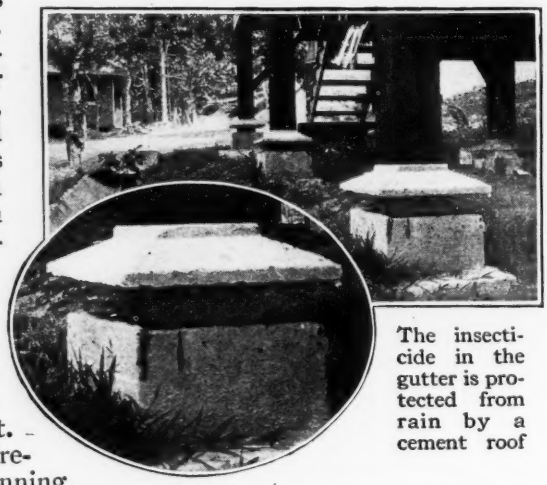


Diagram showing how the two parts of the tractor device fasten over the wheels of the car

Protecting Canal Zone Buildings with an Oil Moat for Insects

IN the Panama Canal Zone ants, lizards, snakes and creeping insects are so numerous and so pestiferous that it is difficult to keep them from climbing up foundation pillars and invading houses. Hence concrete gutters are provided for all posts. Of course, the ants can crawl up the concrete as freely as they can up wood, but when they reach the landing platform of the gutter they find a miniature lake of oil-insecticide awaiting them. They never get beyond this little moat.



The insecticide in the gutter is protected from rain by a cement roof

To prevent the frequent rains from running into the insecticide, a bungalow top, also of concrete, forms a sheltering roof for the gutter.

Enveloping Trees in Freezers to Study Temperature Effects

A CONTRIVANCE designed to freeze whole trees has been constructed at the Utah Agricultural College, Logan, Utah, to aid in experimental work intended to discover, under actual orchard conditions, the frost danger point.

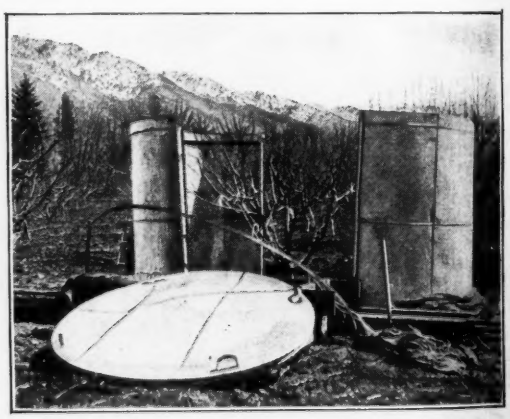
The contrivance is very similar in principle to the old fashioned ice-cream freezer. It consists of a huge galvanized iron tank, large enough to enclose an entire tree. This tank is divided into halves and each half is fastened to a plank base, so constructed that a half can be placed on either side of the tree to be frozen, and the two parts drawn together, completely enclosing the tree.

The tank is double walled, with a four-inch space between the walls. A large lid covers the tank and rests on the inner wall. Ice and salt are packed in between the walls and over the lid. The temperature inside is regulated by pumping in cold or warm air, and the air inside is kept stirred by an electrically driven fan. Four self-registering Weather Bureau thermometers and a thermograph, hung from different branches of the tree, keep an accurate record of the temperature within the tank.

The resistance of buds to frost can be accurately determined by this method and data collected that will tell when smudge pots or other artificial means of orchard heating should be used to save the fruit crop.

The tree is not injured by the process, since care is taken and constant watch is kept to prevent the danger point from being reached.

The tank is double-walled, with a four-inch space between walls. In this space snow and ice are packed just as in a cream freezer



Each of the two sections of the tank is fastened to a plank base. These are drawn together and a large lid covers both halves when joined

When the gourd blossom has faded the bottle should be pushed gently over the young fruit and left there

The rays of the sun through the glass hasten the development. The central picture shows the full-grown gourd

The Gourd in the Bottle. How Did It Get There?

MOST people would be sorely puzzled if they were asked to explain how the gourd comes to be in the bottle shown in the photograph. It is far too large to pass upwards through the neck, and, obviously, it cannot have been pushed downwards. The explanation of the mystery is simple enough. The gourd is grown in the bottle. The trick is easy if directions are followed.

In the first place, the gourd must be properly set before the bottle is placed over it. As soon as the flower is faded the operation may be started. Take the bottle and push it gently over the fruit, taking care not to damage it in any way. Even though the gourd is enclosed in the bottle the growth is not affected in the least. Indeed in a very few days the fruit has developed so much that it cannot be removed from the bottle unless the jar is broken.

When the gourd has grown to a sufficiently large size it may be cut from the stem, and it is then ready for exhibition. After a while the fruit dries, in which state it will keep for an indefinite time. The same principle can be applied to cucumbers, melons, pumpkins and squashes.

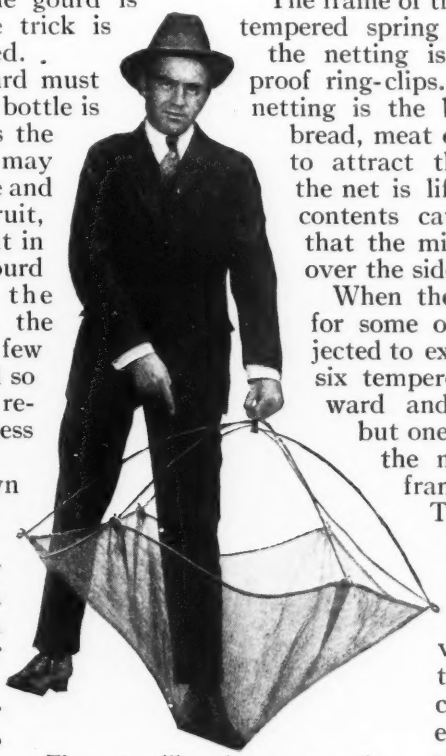
The only precaution necessary is to prevent the fruit from becoming "pot-bound." The stem should be cut as soon as the glass is well filled.

Catching Minnows for Bait in a Basket-Net

PERHAPS the greatest difficulty that the amateur fisherman encounters on his expeditions is the securing of live bait. But if he has included in his equipment a basket-net like the one in the accompanying illustration he can catch minnows and small fish in any stream.

The frame of the net is made from six tempered spring steel rods. To this the netting is attached with rust-proof ring-clips. In the center of the netting is the bait pocket, in which bread, meat or other bait is placed to attract the minnows. When the net is lifted, the weight of the contents causes it to "bag," so that the minnows will not escape over the sides.

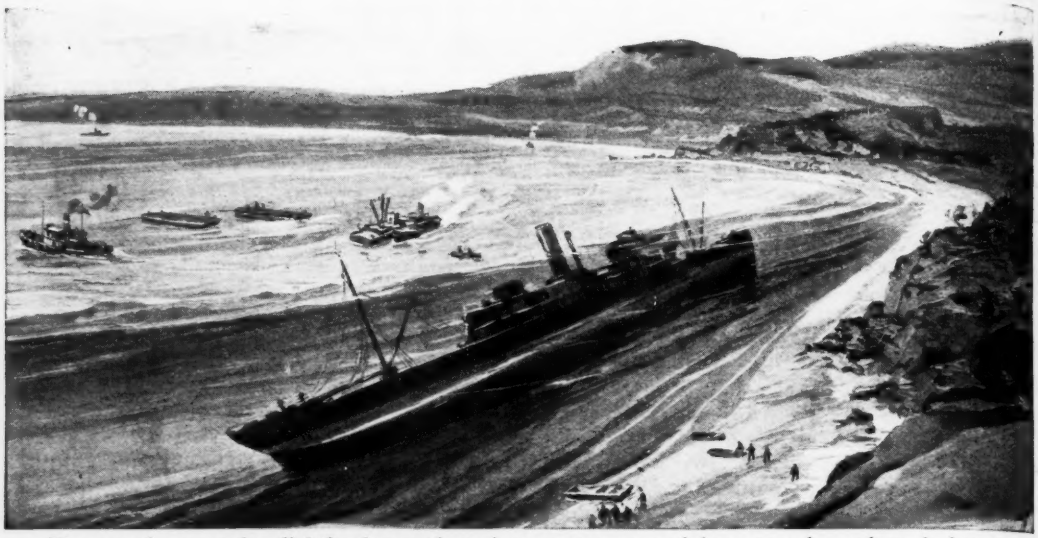
When the net snags or when, for some other reason, it is subjected to extraordinary strain, the six tempered steel rods bend inward and downward until all but one of the rings by which the net is attached to the frame slip out of the hooks. This collapsing of the frame frees the net from the snag and releases the strain. The inventor claims, however, that the net will not collapse except under extraordinary strain, which if resisted would damage the net. It folds up into a compact little bundle which is scarcely noticeable among the fisherman's "traps."



The net will resist strong pulls but will collapse and release the strain under damaging snags

A Sunken Ship That Earned a Fortune

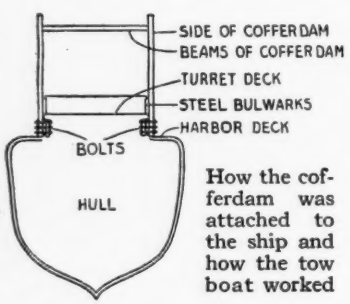
How the Walküre was scuttled, bought for $29,000, raised and sold for $825,000



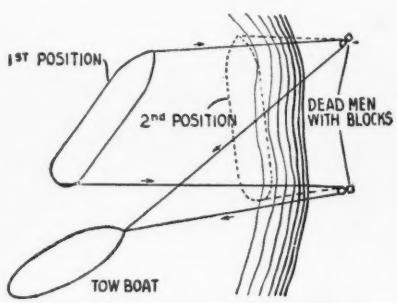
The vessel was only slightly damaged, so her captors opened her seacocks and sunk her to prevent further attack. Only her two masts, stack and flying bridge remained visible above water

THE German freighter *Walküre* was loading phosphate rock at the Island of Makatua when the war broke out; then she was captured by the French gunboat *Zelée* and taken into the harbor of Papeete, Tahiti. Later on the two German warships (the *Gneisenau* and *Scharnhorst*) appeared at Papeete, sank the *Zelée*, wrecked the town, and punctured the *Walküre* above waterline with a few small shells. The French decided to prevent further damage in later attacks on the *Walküre* by opening her seacocks. She sank in fifty-four feet of water.

The *Walküre* is built like some old French war vessels and some Scandinavian freighters. Her sides rise out of the water for about twelve feet, curve squarely inward a distance of ten feet, forming what is known as the "harbor deck," then rise some eight feet to the main or turret deck. Because she was thus built she was salved in a novel way.



How the cofferdam was attached to the ship and how the tow boat worked

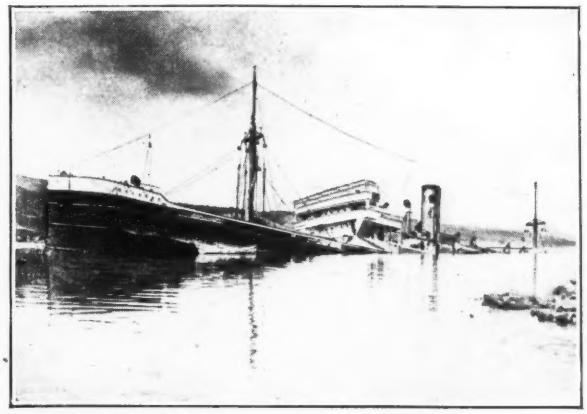


She is a single-screw steel vessel, 350 feet long, 49 feet beam, and 24 feet depth. Her gross tonnage is 3,836; net 2,403; dead weight capacity, 6,700. She has triple expansion engines with an indicated horsepower of 1,800. Her bunker capacity is 1,300 tons. Her speed on trial trip was 10.5 knots.

At the time the vessel met her fate, she was 3,670 miles from San Francisco and was sunk about 300 feet from shore, resting on a sloping bottom with a slight list and with some ten feet of water over her turret deck forward and about thirty feet aft. Only her two masts, stack and flying bridge remained visible. For nearly a year she lay thus. Eventually she was put up for sale by a French prize court and was purchased by Mr. John A. Hooper of San

Francisco for less than $29,000. Her original cost was $210,438.00.

Mr. Hooper is a lumberman and not an engineer. Nevertheless, it was he who devised a plan for raising her. From photographs of her, maps and other data, he decided that if all the shell holes were stopped, if her sides were extended upward until they protruded out of the water, and if the water were then pumped out of her hold and out of the extension top, she would rise of her own accord. Why? Because the volume of water displaced by the extension form outweighed the force tending to buoy her up, and when removed left no alternative but for the vessel to float. The form, or cofferdam, as that kind of structure is known, was built to displace 4,500 tons of water.



The Walküre rose to the surface like a cork as the water was pumped out of the cofferdam

There was assembled in San Francisco and sent to Papeete the material for a wooden cofferdam 307 feet by 14 feet in height forward and 32 feet aft, plus an additional 25-foot section in the form of a V and also 32 feet high, to encompass the stern. The material assembled included some 600 tons of tongue-and-groove planks, beams and joists, 13 tons of structural iron, chains, hangers, pipes, etc., four direct connected centrifugal pumps, one double-action Worthington pump and two pulsometers.

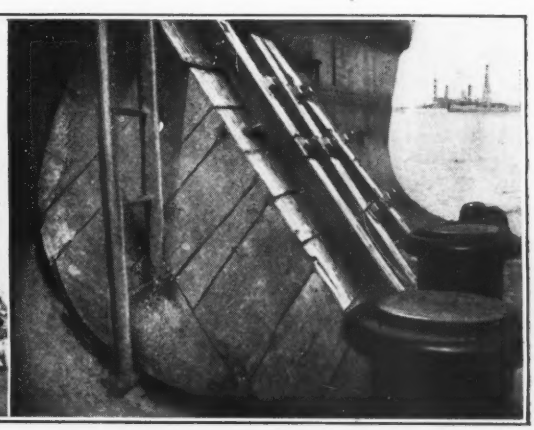
Divers were sent down to patch up the *Walküre*. Then the first 18-foot section of the cofferdam, constructed on shore, was lowered into place. The cofferdam was constructed of 2-, 3- and 4-in. planks, the thickness increasing with the depth of immersion. These were bolted and nailed to the joists, the entire construction resembling a huge water-tight rectangular box without top or bottom.

Resistance against the exterior crushing force was secured by use of transverse beams 14 by 14 in., reinforced by longitudinal supports 6 x 8 and 8 x 10 in., tying together the different sections.

Next the water was pumped out. When the vessel floated a little she was towed a little nearer shore. The first movement of 125 feet was followed by a second of 146 feet on the following day. Pumping was then stopped and five days spent in sawing away the elevated portions of the cofferdam in order to provide stability and remove weight and topheaviness. One day later the vessel was afloat on her own bottom and the process of cleaning up was begun.

Four weeks were spent in getting the

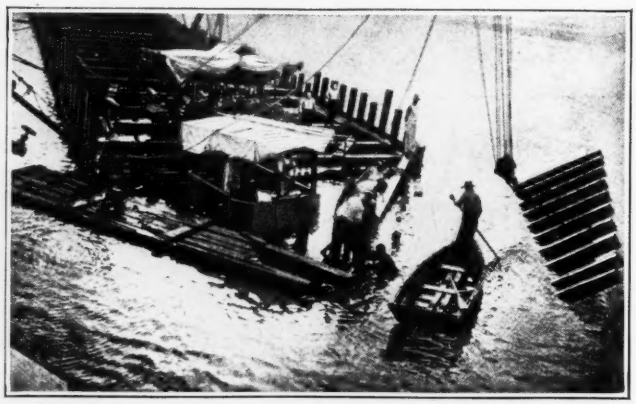
One of the shell holes made in the Walküre's hull after she was captured by the French



How the big shell hole shown at the left was plugged up before the pumping began

vessel ready for sea, her engines and equipment being found in very good condition. The two thousand tons of phosphate in her hold were left in place. Her cargo of 1,300 tons of coal was used on the trip to San Francisco. Before departing the vessel was christened *Republic*, and given American registry.

When she reached San Francisco the ship was thoroughly overhauled and repaired at a cost, including the salvage, of $255,000. Yet such was the scarcity of ships that she soon paid all expenses incurred. On one trip alone she netted $360,000. She was finally sold for the sum of $825,000.



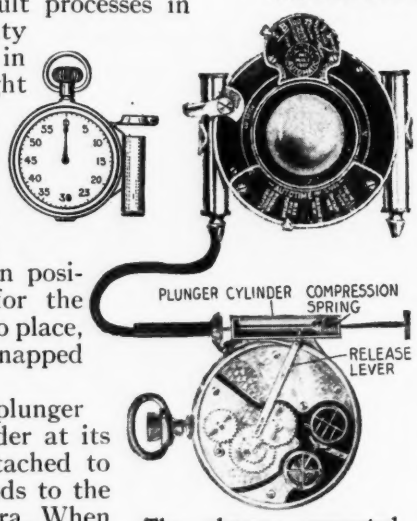
The cofferdam after it had been lowered in place. The thickness of the planks increased with the depth of immersion

A Camera Timing-Release Which Enables You to Photograph Yourself

NUMEROUS methods, electric and otherwise, have been devised to enable a person to photograph himself. Some have proved to be successful, but they are usually tedious and difficult processes in which there is little certainty of success. Few equal in simplicity a method brought out by Ellis E. Bjorling, of Salt Lake City, Utah. The entire mechanism consists of a modified watch which can be carried about in the pocket. After the camera has been placed in position, the watch is set for the time it takes you to get into place, when the picture will be snapped immediately.

The watch has a moving plunger mounted in a small cylinder at its side. A flexible cable attached to the end of the plunger leads to the shutter-release on the camera. When the plunger is pressed inward towards the end of its cylinder, it compresses a spring. The plunger is held at the end of the cylinder by a spring-latch which projects into the cylinder from the inside of the watch. The moving inward of the plunger will have also moved the cable, so that the camera-shutter is now set for the picture.

After this adjustment, the watch can be set to trip the plunger with any period of time not exceeding forty-five minutes. During this interval, in which you are getting into position in front of the camera, the spring-latch will be gradually pressed down by a lever. This lever is slowly turned by a pin on the minute-hand gear. It is provided with a cam at its end. If the watch has been adjusted for forty-five minutes, after three quarters of an hour the cam will have pressed the spring in from the cylinder. The plunger will be tripped and it will jump back, pulling the cable along with it. This operates the shutter.



The plunger connected with the shutter is pressed in against the spring by the turning of the watch

Ten Thousand Medical Officers Are Needed for a Million-Man Army

THERE are about one hundred and fifteen thousand physicians in the United States to care for the civil population and provide medical officers for the Army and Navy. In the event of an army of one million men being called to the colors, seven thousand medical officers, or about six per cent of the physicians who are in the actual practice of their profession, will be needed at once, and three thousand will later be needed for emergencies. This means that ten thousand physicians will have to be entirely detached from their home practice. It will require seven hundred others a year to replace losses.

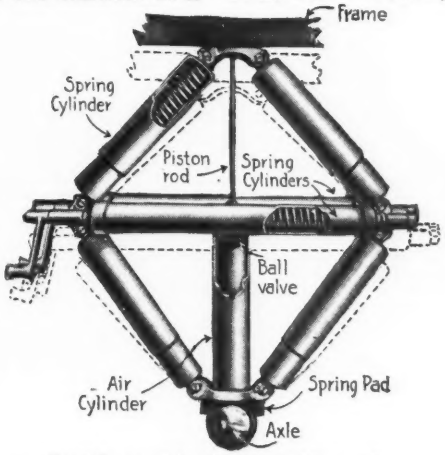
A Combined Automobile Spring and Shock Absorber

A CANADIAN, Henry Dixon, has invented a device which combines the functions of an ordinary automobile spring and a shock absorber. The same degree of elasticity may be maintained between the lightest and heaviest loads in order to reduce the sudden bound and rebound so uncomfortable to the passengers of a car.

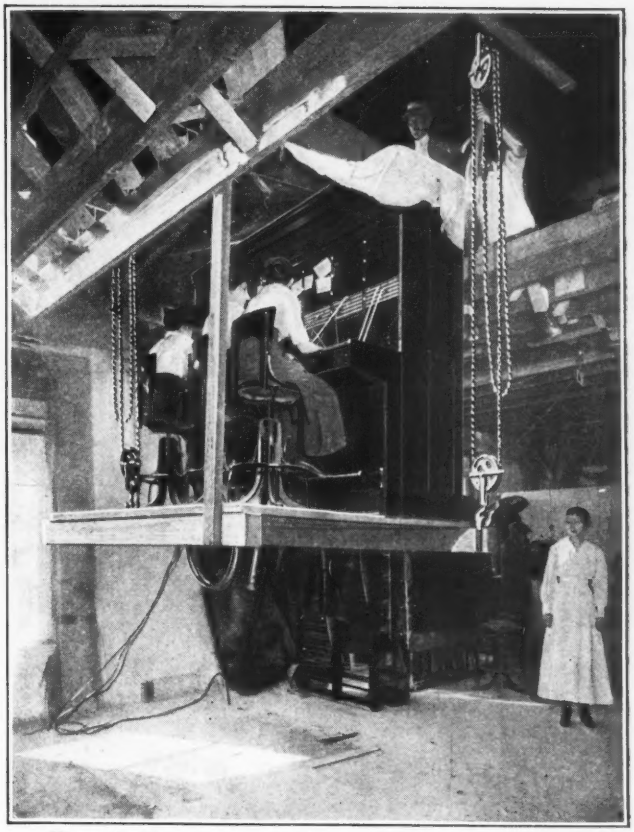
The apparatus consists of one vertical air cylinder and piston mounted on a yoke, at the bottom of which are pivoted two inclined spring cylinders. These in turn are connected with two other oppositely inclined cylinders pivoted to a top yoke and with two other similar horizontal spring cylinders spaced on either side of the vertical air cylinder.

Each of the cylinders has a piston, that in the air cylinder being provided with a ball valve by which air may pass from one side to the other, and those in the spring cylinders with washers at the ends which serve to compress the springs under action.

The device is inserted between the vehicle frame and each of the springs. When subjected to an excess load or to concussion, as when the vehicle passes over ruts or car tracks, the four inclined spring cylinders straighten out in the manner of a toggle and exert great endwise pressure, to compress the springs and increase their natural force in the ratio of their compression. This compression is retarded, however, by the resistance of the air in the center vertical cylinder and by the springs in the two horizontal cylinders. The return of the cylinders to their normal position is effected by a gradually diminishing force, this action tending to reduce sudden bounds and rebounds of the body.



In this combined automobile spring and shock absorber the same degree of elasticity is maintained between the lightest and heaviest loads



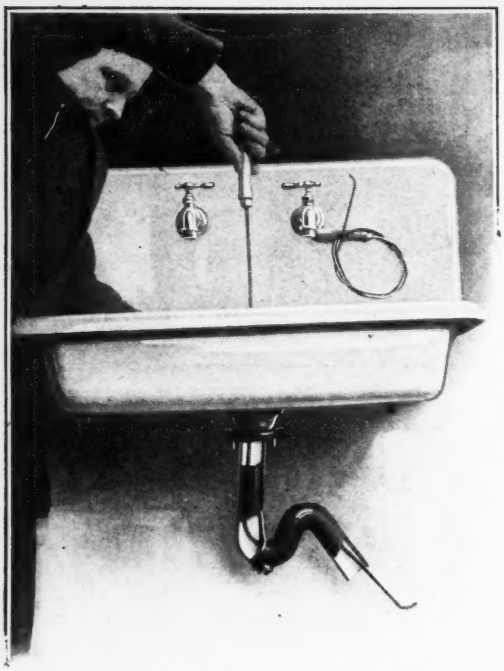
The switchboard and operators were raised by easy stages to the floor above and not a call was missed. This was made possible by lengthening the switchboard cable

Moving a Telephone Switchboard Without Interrupting the Service

A TELEPHONE company at West Palm Beach, Florida, recently added a floor to its building and raised the operating switchboard one flight up into the new addition.

The switchboard was moved to a temporary platform, to which powerful chain falls were attached. A half dozen rafters of the new floor had not been placed in position, so that the platform could be raised through that space.

During the movement the three telephone girls continued their work unconcerned, answering calls and asking for numbers as usual.



"Sweeping" out a joint of plumbing with the new flexible wire device

A Pipe-Cleaning Wire Which Worms Its Way Around Bends

TROUBLE with drain pipes which continually clog up can very easily be done away with by the use of a steel cable devised by Jay H. Woolhiser, a plumber of Elmhurst, Long Island.

Unlike the straight steel cables which cannot be pushed around a sharp bend, his wire can wind around the worst of them, cleaning out the waste while doing so. The wire is made of thin, but very elastic steel. This is wound around in small loops placed very close together.

The end of the wire is slightly bent, and this end is slanted away from the direction of the pipe bend. When the wire reaches the bend it therefore catches. The wire is pressed down into the pipe a little further, and is then suddenly turned. The wire end is at once released and the wire springs up into the bend.

When the waste which is clogging the pipe is reached, the wire is kept turning. The bend of the wire keeps the end swinging around in a circle. It thus wipes around the whole interior of the pipe.

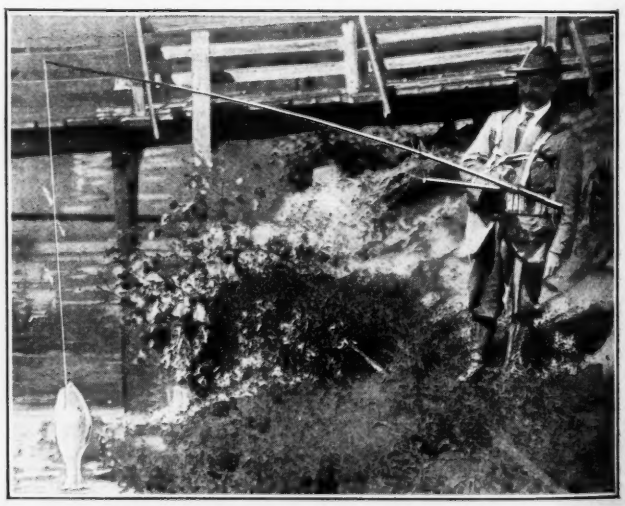
What One Gallon of Gasoline Might Be Made to Do

THE power of gasoline is generally rated by the distance it will propel an automobile. But the same energy, if directed to other and more varied purposes, will milk three hundred cows, bale four tons of hay, mix thirty-five cubic yards of cement, plow three-fifths of an acre of ground, or it will generate enough electricity to light a large farmhouse for thirty hours.

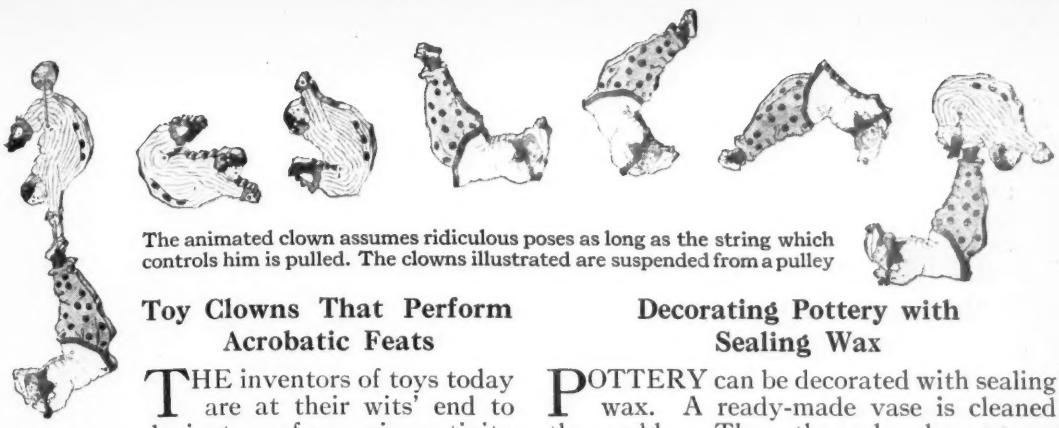
How to Take a Drink and Eat While You Are Fishing

THE fisherman need not lose any time, from his sport in order to eat, but may have his hands free for attending to his needs if he is equipped with the new fishing harness invented by Kenton Drinkard, Beaumont, Texas. This harness supports the fishing pole in the proper position for the line to make a catch, and the fisherman need not hold his arms in one position until they are cramped and aching while he is waiting for a fish to find his bait.

The device includes a body belt having a socket which receives the butt of the fishing pole. A second socket on the belt supports a bracket arm which extends part way out under the pole and in turn provides a support or rest for it. A body strap and chain attached to this brace, affords all the additional support necessary. Equipped with this device the fisherman may enjoy his fishing interruptedly.



A belt fastened around the body is provided with a socket into which the pole fits, leaving the hands free



The animated clown assumes ridiculous poses as long as the string which controls him is pulled. The clowns illustrated are suspended from a pulley

Toy Clowns That Perform Acrobatic Feats

THE inventors of toys today are at their wits' end to devise toys of excessive activity and laugh-producing antics at the behest of the up-to-date youngster. The most effective of these toys are usually the simplest in principle.

The illustration shows an excessively active clown, or two of them, suspended from a pulley, over which they may be made to dance and perform any number of feats. The figures are flat, but with various indentations and angles, so that they are capable of assuming many ridiculous poses, interlocking occasionally, and balancing one another in approved clown style. The contortions are kept up just as long as the string which controls their action is manipulated.

The inventor of the daring acrobats is Henry A. Hart, of Flushing, New York.

Decorating Pottery with Sealing Wax

POTTERY can be decorated with sealing wax. A ready-made vase is cleaned thoroughly. Then the colored wax you have selected is softened in an alcohol flame. Holding the vase upside down, apply a daub of the wax. Move the vase vertically up and down in front of the flame to spread the wax. Apply additional daubs to the surface and spread them out in the same way until the entire surface of the vase is covered. The heat from the flame thins out the wax and glazes it. Thus a one-colored coating is obtained.

More pretentious effects are made by "flowing" a wax of one color into another of a different hue. After the tonal color has been applied over a portion of the vase, a daub of another color is allowed to flow into the first color in such a way that no line of joining is formed. The secret of success lies in manipulating the flame.

The colored wax is heated over an alcohol flame and then applied to the vase

Why Do Rifle and Shotgun Barrels Burst?

ALTHOUGH shotguns and rifles are tested with loads which give pressures far above those produced by ordinary ammunition, swollen or burst gun barrels are not uncommon. The cause is either attributed to defective ammunition or to an obstruction in the bore, such as snow or dirt. The pressure of the powder gases themselves are not to blame, for investigation has proved that the swelling or rupture is caused by the compression of the air between the bullet and the obstruction.

Queer Rivers Which Are Natural Curiosities

AMONG the natural curiosities may be mentioned several rivers. There is a river of pure black ink in Algeria, formed by the union of two streams, the water of one being impregnated with iron and the other with gallic acid, drained from a great swamp. Kentucky has its Hidden River, the origin of which no one knows. It vanishes into a deep cave and is thereafter lost. In Siberia a tributary of the Lena River runs over soil deposited on a layer of ice nine feet thick.

A Trowel Which Places and Molds Concrete Curbs

AN adjustable trowel which greatly increases the speed at which concrete curbs can be made, has been devised by Charles Upham, of Odell, Illinois. The mere adjusting of its horizontal top-arm will vary the height of the curb as the trowel is pushed along over the roughly-shaped concrete previously placed along the road.

The trowel is made in three pieces. The two side arms are held facing each other at the proper distance by the top arm between them. This arm slides up and down the slots shown in the side arms. In these the height adjustments are made. The top arm is flared so that it continuously pushes the concrete downward while being guided over it. A more compact mass is thus formed than the ordinary flat trowel could produce.

As the trowel is pushed along, the top arm is adjusted to the required height, thus shaping the concrete

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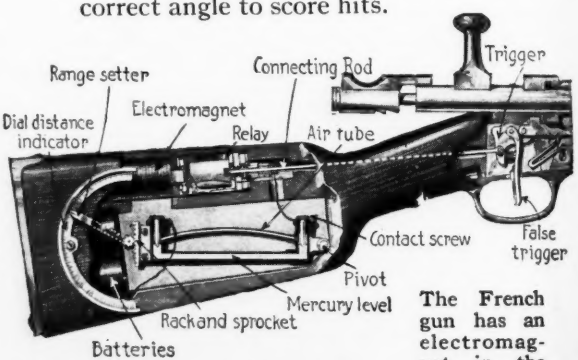
Three Separate Plans for Making a Gun Think

MILITARY rifle designers have little faith in the intelligence of troops. The crude and rough-and-ready sights they install and the fool-proof mechanism go to prove this. Their latest idea is to make the rifle refuse to fire when pointed at the wrong elevation—and even to fire itself when pointed at the correct one. Nearly all errors in battle are errors in the elevation of the rifle; the bullets strike too high or too low. The battle lines, being long, usually take care of side errors.

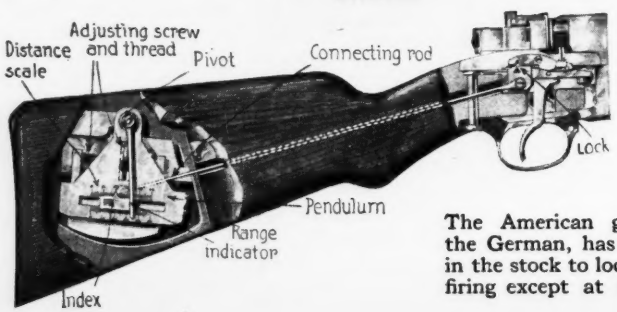
A German, A. Müller, a Frenchman, E. Bourdells, and an American, Captain Eley, have all three independently conceived the scheme of an arrangement in the stock which will prevent the rifle from being fired save at the correct angle.

The Frenchman's idea is to place an electromagnet in the stock. The electromagnet controls the action of the trigger and locks it normally against releasing the sear of the gun. A mercury column in the stock closes the electromagnet circuit when the gun is held at the correct angle, unlocks the sear, and permits the soldier to fire the gun. If the angle is not correct, the mercury fails to touch both ends of the open circuit, and so the gun remains locked.

The German and the American ideas are practically alike in principle in that they make use of a pendulum, or pivoted and swinging weight in the stock of the gun, to lock the sear against firing, save when the gun is at the correct angle to score hits.



The French gun has an electromagnet in the stock which controls the trigger action

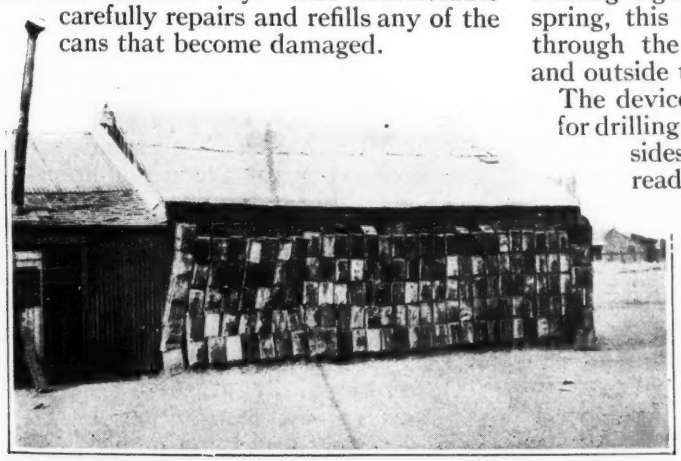


The American gun, like that of the German, has a pivoted weight in the stock to lock the sear against firing except at the correct angle

Stopping Mexican Bullets with Sand-Filled Oil-Cans

WHEN residents of Naco, Arizona, a border town, began to barricade the walls of their homes against Mexican bullets, one man made a visit to the town dump and obtained every available five-gallon coal oil can. These he filled with sand and then built a wall with them against the side of his house facing the Mexican line, about two hundred yards distant. About one hundred and fifty of the cans were required but he had little difficulty in finding this number; for Naco, like hundreds of other Western towns, is a place where coal oil is not sold "loose," but is obtainable only in square tins holding five gallons each.

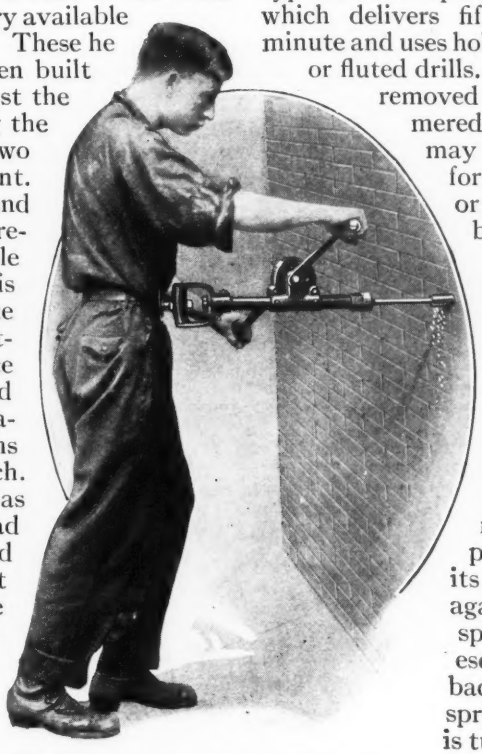
When the task was completed the man had the equivalent of a solid wall of sand a foot thick along the side of his home. During a battle fought on the Mexican side of the town in January, 1915, when the Carranza forces holding Naco, Sonora, were attacked by Yaqui Indians, hundreds of bullets came across the line and this unique barricade stopped all that came its way. The homesteader carefully repairs and refills any of the cans that become damaged.



A solid wall of sand-filled oil-cans forming a barricade a foot thick along the side of the house facing the Mexican line

Drilling Holes in Concrete with a Crank-Operated Spring-Hammer Drill

DRILLING holes in concrete has always been tedious and slow. It has been quickened by the introduction of a new type of crank-operated spring-hammer drill which delivers fifteen hundred blows a minute and uses hollow drills instead of star or fluted drills. Hence all the material removed is pulverized or hammered to a dust. The device may be used as a breast-drill for holes in vertical walls or for holes in ceilings or beams.



The new type of crank-operated spring-hammer drill used as a breast drill

The drill consists of a hollow barrel in which reciprocates a piston or hammer against the compression of a spiral spring at the handle end. The movement is produced by a ratchet-wheel turned by two hand cranks. As the ratchet is revolved the piston carrying the drill at its free end is forced back against the compression of the spring. As the ratchet tooth escapes, the piston jumps back under the expanding coil spring. The faster the ratchet is turned the greater the number of blows transmitted to the drill, which is rotated in its socket in the usual manner. The tension of the spring may be adjusted to vary the force of the blows by means of a collar bearing against the handle end of the spring, this collar being moved in or out through the medium of a threaded bolt and outside thumbscrew.

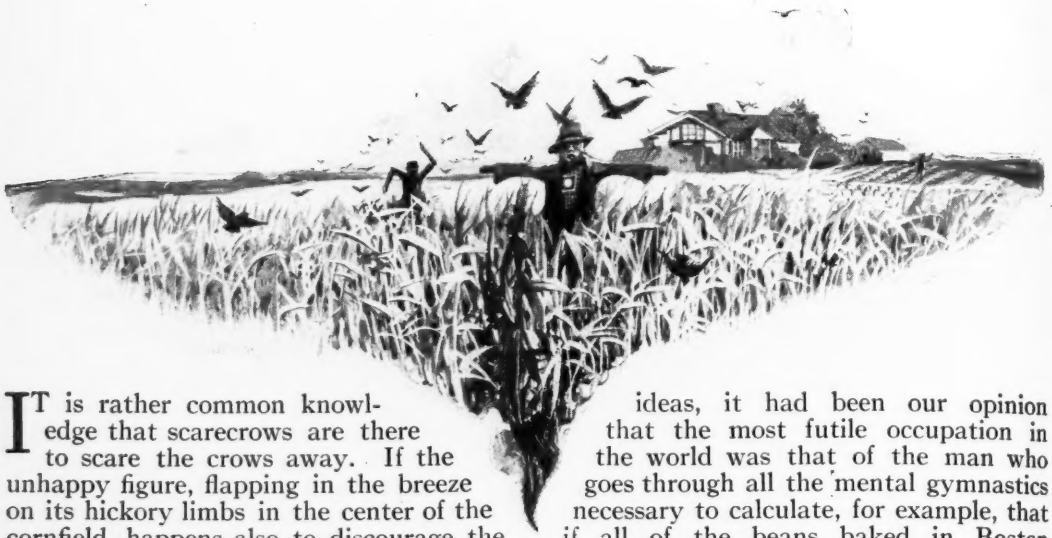
The device has a telescoping extension for drilling holes in ceilings and the undersides of beams. It has found a ready market among the firms making and installing sprinkler systems on account of the ease with which the holes are drilled for the supports to hold the sprinklers in place.

Plumbers and heating and electrical contractors make use of it for drilling in concrete, brick walls or stone for expansion bolts, pipe hangers and the like.

Entertaining the Crow

The modern scarecrow is a yelling gymnast that twirls with the wind

By George Wörts



IT is rather common knowledge that scarecrows are there to scare the crows away. If the unhappy figure, flapping in the breeze on its hickory limbs in the center of the cornfield, happens also to discourage the advances of the sparrow and the coyote, your average farmer is perfectly satisfied.

For the same reasons that childless individuals know much more about raising sons and daughters than do fathers and mothers, persons who have never been nearer a farm than the observation platform of a fast train, know all about scaring the crows away.

Recently, several humorists, disguised as inventors, brightened up the columns of the Patent Office Gazette with various improvements upon the time honored, flapping, cornfield variety of scarecrow. While their inventions are labelled scarecrows or "crow jacks," the descriptions which accompany them are delicious satire. The inventors seem to have decided to furnish everybody with a laugh, from the employes in the patent office to the crows in the cornfield. Each one of the little group of humorists was positive that the average farmer is not pleased with the dividends, so to speak, which his old suit of clothes draped over the usual hickory limbs or old broomsticks has been declaring.

The cornfield gladiator who waves his swords with the wind

Before these merry-makers appeared with their side-splitting ideas, it had been our opinion that the most futile occupation in the world was that of the man who goes through all the mental gymnastics necessary to calculate, for example, that if all of the beans baked in Boston during one week were placed end to end, they would stretch from Hoboken, N. J., to Mars, with enough left over to pave a road twenty feet wide from Gallapolis, Ohio, to Moose Jaw, Saskatchewan. But we overlooked the occupation of inventing improvements for old man scarecrow.

On the other hand, why waste time improving the hickory-and-old-clothes scarecrow of our forefathers? Why not adopt the scheme that a New York man applies to hens?

"The hen is instinctively a well mannered bird," says this poultryman. "Be polite to her, and she will roost awake nights, hatching schemes to increase her output."

What stands in the way of applying this plan to scarecrows? A crow jack with a phonograph attachment which repeated in a soothing voice at intervals, "Please go 'way, Mr. Crow," should find the birds too polite to steal other folks' corn. They would flap their wings in embarrassment and fly guiltily away. This suggestion is offered to scarecrow inventors absolutely gratis. Compared with this idea, some of the schemes of the humorist-inventors are lacking in

breadth of imagination and practicability.

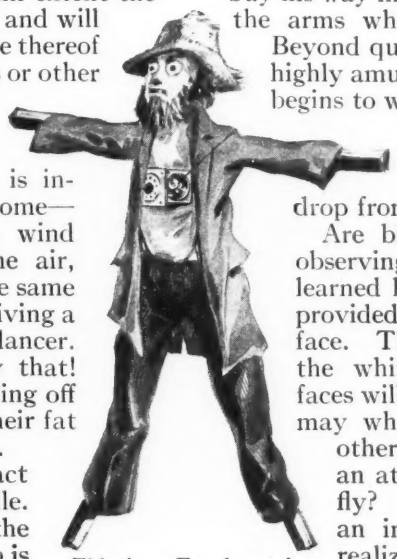
Consider Exhibit "A," which originated somewhere in Maine. It borrows from the windmill for its particular vein of humor. Or, as cleverly expressed in the patent paper:

"The object of the *present* (the italics are ours) invention is to provide a crow jack which will simulate to a certain extent the movements of a human being and will present the external appearance thereof so as to scare or frighten crows or other birds."

Does not that paragraph fairly bubble with laughter?

The "present"—by which is inferred that there are more to come—cornfield classic, when the wind blows, flings its arms in the air, Indian club fashion, and at the same time spins about on one toe, giving a quaint imitation of a cabaret dancer. How the crows would enjoy that! One can see them fairly toppling off the fence rail and clutching their fat little sides in spasms of mirth.

Let us pass on to the next act of this sparkling vaudeville. Ladies and gentlemen — the coyote alarm (at right). Iowa is responsible for this. It looks like a man, but hist!—it is an invention! Where the man's innards ought to be, lies a mechanism.



This is a Frankenstein creation. It resembles a man but in his chest is a mechanism of springs and cogs. At regular intervals he gives vent to a great bellow

What might be an orderly, gentlemanly scarecrow has been transformed into a creature with lungs of strong steel. In some respects it resembles an alarm clock. Every once in a while a cog disengages itself, and the racket may be plainly heard for miles around. If I were a crow, however, I think I should sneak up and investigate, out of the stubborn curiosity so characteristic of the crow. But perhaps not.

Now contemplate the dude of the scarecrows, with his neatly fitting suit and hat and heavy eyebrows.

It usually costs an inventor no less than $100 to gird the loins of his brain child with the decency and the protection of the law. But the Ohio man who squandered his money to give this gem to the clamoring public may be wealthy. Anyway, the Patent Office Gazette is one of the few magazines in existence which permit a man to buy his way into print. In a fair wind, the arms whirl and the body spins. Beyond question, the crows will be highly amused when the little dandy begins to wave his arms and revolve in the wind. If they watch the performance long enough they might drop from sheer dizziness.

Are birds and beasts of prey observing? If so, they have learned long ere this that Man is provided ordinarily with only one face. Therefore, the intentions of the whirling dervish, with two faces will go far afield. The thing may whirl with the wind as the others do, but what crow with an atom of common sense will fly? Unless he happens to be an intemperate bird, he will realize that two faces are not the proper number for a man!

Perhaps the cornfield gladiator pictured on the preceding page might achieve his purpose by causing the crow to laugh itself into apoplexy. If he should clash his arms in today's cornfield, your up-to-date bird would execute a Charlie Chaplin glide. He might even stop to whistle an old tune, popular ages ago, entitled "Where did you get that hat?" For the average twentieth century crow is a wise old bird and tame enough to eat from the hand of any scarecrow he chooses.

At left is a two-faced monster with weather-vane arms. He revolves with the wind. At right is the dude of the scarecrows. His partner beside him not only whirls and twirls as the others do but bobs his head fiercely as well

Rubber—An Armor Against Disease Germs

It is the shield and buckler of quarantine inspectors and health officers in general

WHILE immigration from Europe has practically ceased because of the war, the number of ships coming into our ports daily is still large, and the work of the quarantine officers at New York city has in no way diminished in importance.

In examining possible carriers of disease, whether they be human beings or animals, the greatest care must be exercised by the inspectors lest they themselves be infected or their clothing offer hiding places for the germs. Here is where rubber comes in as an armor. Rubber uniforms are worn which cover the entire body from head to foot. These are worn by nurses and doctors alike and rubber gloves complete the outfit. The clinical thermometers used are held in a hard rubber case. It is not so much from fear of personal consequences that the inspectors, attendants and nurses use the rubber garments, as to facilitate disinfecting and washing up afterward.

Where typhoid fever is suspected, the suspect, or "contact," as such a one is called, is removed at once to a ward set apart for the treatment of contagious diseases, while those remaining on board ship are segregated and subjected to an antiparasitic bath. Each contact has an identification number which is hung around his neck on a rubber cord, or necklet.

During the recent foot-and-mouth disease epidemic among cattle, the quarantine officers were called upon for quick and radical action. An army of 1,000 inspectors was formed and every farm and stockyard in the state was visited and thoroughly investigated. Each inspector was clothed in rubber from head to heel, and in addition he was provided with a rubber fumigating cape and a tin basin and sponge, in order to give his rubber clothing a germicide bath of bichloride of mercury after each inspection.

Disinfecting and fumigating the inspectors' clothing. The fumigating cape completely covers the body

In order to disinfect the clothing lying closer to the body, a white rubber fumigating cape was fastened snugly about the inspector's neck and its folds spread out like a tent over a fumigating mixture composed of formalin and permanganate of potash. When these in their crystalline form are mixed, a vigorous reaction takes place and a large quantity of formaldehyde gas is liberated. Thus, before an inspector left a place, all of his clothing, whether of cloth or rubber, was thoroughly disinfected and as thoroughly fumigated.

The actual disinfecting of barnyards, stables, stockyards and the like was of course carried out on a larger scale than would be possible by hand distribution of the germicide. In some places, for instance, the inspectors were provided with steam-driven disinfecting pumps capable of spraying a large area very quickly. Each pump had at least one hundred feet of hose.

In examining cattle for evidences of foot-and-mouth disease, rubber gloves and aprons are a prime necessity

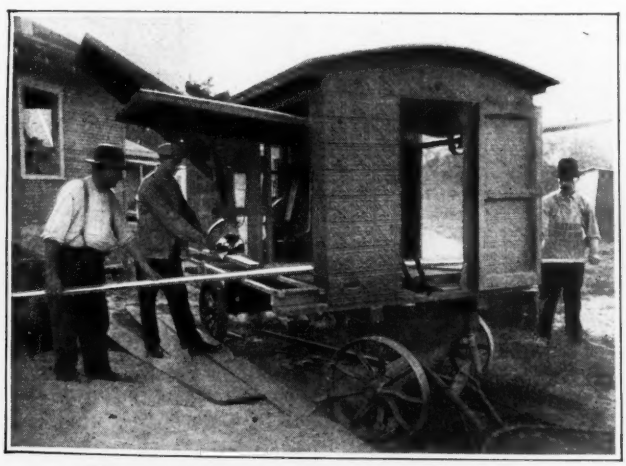
This Contractor Carries His Power Shop to His Job

IT is not always the fault of the contractor when a house is not completed on schedule time. Often exasperating delays are caused when woodwork must be sent to factories to be cut, or when different kinds of special work require power machinery.

B. F. Brown, an architect and builder of Brookfield, Mo., has found it an advantage to build his own power shop and to mount it on a truck so that wherever he goes it may go, carrying with it gas-engine, rip-saw, plow, rabbet, dado, planer, swing cut-off saw, 18-inch sandpaper drum and five special machines. Other equipment includes a cut-off table provided with a frame roller attachment. This table also answers as a workbench.

The little shop on wheels is storm-proof, so that it provides a convenient locker for tools. It was designed and built by Mr. Brown, himself, who claims that almost any kind of work in the way of framing, cutting and smoothing may be done in it as conveniently as in a great power factory.

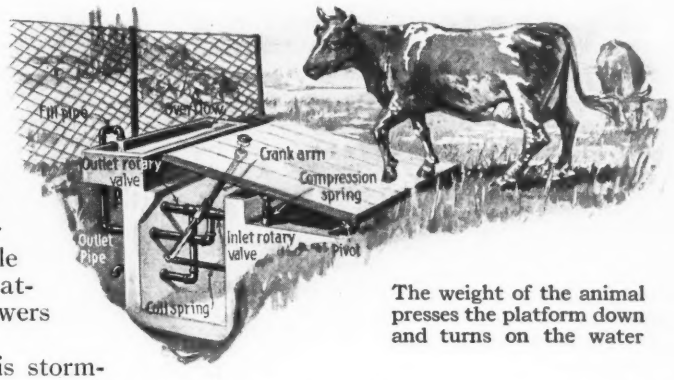
The doors of the portable shop open up in such a way that they form a kind of shed under which the workmen and the machines may be somewhat protected from rain and sun when the work is to be done just outside of the shop. There are six of these doors in all—two on each side and one at each end.



The portable power workshop. Like Mary's little lamb it goes wherever its owner goes

The Intelligent Trough. It Measures Out Water to the Thirsty Animal

IT'S a wise trough that knows how much an animal wants to drink. But that such wisdom is not impossible is shown in the trough illustrated. There is a platform which works in conjunction with valves on the supply and drain-pipes of the trough. When a horse steps on the platform the valves are opened and a stream of water pours in. As he slakes his thirst and steps off the platform the inlet is closed and the surplus water is drained off.



The weight of the animal presses the platform down and turns on the water

The credit for the device belongs to Victor A. Millen, of Ohio. The valve mechanism of his device is mounted in a concrete well in the ground. The valve of the supply-pipe and the valve of the drain-pipe are mounted side by side. The stems of both valves fit into a single operating lever as shown in the illustration. Hinged above this mechanism at the level of the ground is the platform. The front end of the platform is raised slightly by a pair of springs and is connected with the lever of the valves. The water trough lies just in front of the platform. You can see at once that as soon as a horse walks on the platform, he presses the front end down and opens the valves of the trough pipes. The water gushes in at just the rate that the average horse will drink. His thirst quenched, the horse leaves the platform, the springs raise it up and close the valves. Very little water is wasted, and the drink furnished the thirsty animal is as cool and fresh as that which is supplied to the farmer and his men.

Carrying the Cook-Stove on the Automobile Trip

WITH the advent of the summer season the automobile assumes a still greater importance in the life of the possessor, and its equipment requires expansion. Nature fairly shouts imperative calls to far-away places. Unfortunately, when the calls are obeyed the obedient ones often find their hunger for the vast out-of-doors appeased at the expense of their more material appetites. Sandwiches, however attractively made up, are not continually satisfying. The truly wise will provide a small stove, on the order of the one illustrated, on which really appetizing little meals may be prepared.

The tiny gasoline stove folds up into a box after the meal is cooked

The one shown is nine by nine by four inches and weighs only eight pounds. It has one burner and a tiny oven. Gasoline is used for fuel. The tank is protected from the flame by means of a jacket, double air chamber and a partition. It holds enough gasoline for one and one-half hour's continuous use, and may be replenished from the tank of the car.

At What Age Does the Athlete Begin to Lose Form?

"THREE score years and ten," tradition says, is the span of a human life. This must be divided into three periods to include preparation, efficiency and decay, each period lasting nearly twenty-five years. With the athlete, it is still more severe. Few men at thirty-five, it is said, have the reserve vitality and endurance that they had at twenty-five. Therefore the edict has gone forth that at thirty-five the athlete must let up in violent competitive work and gradually back out of the front ranks.

But there is no scientific evidence to show that this is necessary. The human body is simply an assemblage of cells, which must be kept active without being over-strained and nourished without being overfed, in order that they may be able to resist the attacks of microscopic enemies which cause disease and decay. Under favorable conditions these cells will live indefinitely without showing signs of age or loss of vitality. Therefore the conclusion is reached that the "three score years and ten" are not fixed by any natural law but rather by the conditions under which men live and by their personal habits. The athletic champion, then, who lives under the best hygienic conditions and observes the law of temperance in all things and at all times, *should* be able to "sit tight" on his pedestal so long as he desires.

A Novel Bicycle Exerciser for the Wounded Soldiers

THE accompanying photograph shows two soldiers sufficiently convalescent from leg wounds to be in need of exercise. On this novel bicycle they are afforded companionship as well as exercise.

Two bicycles minus their front wheels and supported by iron braces enable two men to exercise at the same time

A Flowery Conception of the Western Hemisphere

AN inmate of the Soldiers' Home, at Atchison, Kans., has conceived a plan which makes the lawn in front of the Home the most conspicuous and admired object for miles around.

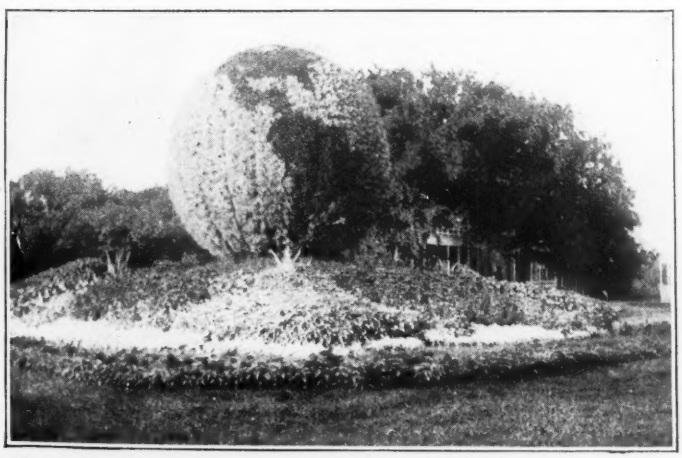
A huge framework of closely woven galvanized wire in the form of a sphere has been placed in the center of a terraced flower bed. This sphere is filled with rich soil in which are embedded hundreds of tiny plants, which are trained to grow out through the mesh. A perforated pipe runs up through the center of the sphere and keeps the flowers watered.

The design is changed with the seasons to prevent monotony. At present the Western Hemisphere is outlined in red, white and blue. The land spaces are filled in with red and white flowers and the oceans with blue. The Stars and Stripes, also in red, white and blue, furnish a popular variation. No doubt airplanes and bursting bombs will find a place on the flowery globe sometime before this year is out, for the gardener is bent upon depicting in flowers the patriotic sentiment of the moment.

The fruit is cut off and dropped through a long cloth sleeve into a pail

Picking Fruit from Tall Trees While Standing on the Ground

INSTEAD of wasting time in climbing trees to pick fruit, George J. Fallkin, of San Jose, Illinois, gathers his fruit while standing on the ground. He simply uses a long cutter-pole having a metal cup mounted on its end. A set of knife blades are arranged near the top of the cup. The pole is brought up to the fruit in the tree until the fruit is well inside the cup. A string is then pulled. This causes the sharp cutting blades to sever the stem of the fruit. The fruit falls into the cup, the bottom of which opens out under the weight of the fruit and allows it to drop down through an opening and into a long cloth sleeve. When the sleeve is filled up, the fruit is dumped into a pail or basket. By this method there is no danger of bursting choice fruit and thus decreasing its market value and keeping quality.



The spherical garden at Soldiers' Home, Atchison, Kansas. The land is designated by red and white and the oceans by blue flowers

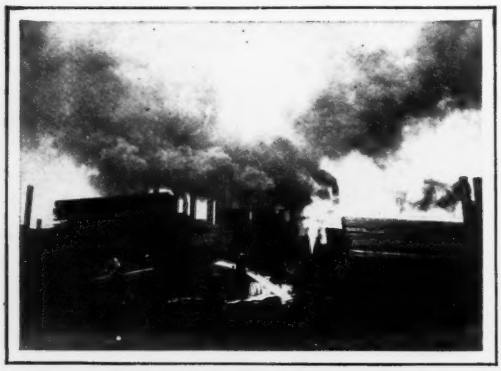
What the War Has Cost the Fighting Nations Thus Far

ON February 1, last, the various governments at war had spent something like seventy-one billion, seven hundred and forty million dollars. How much money is this? Can we comprehend it? If it were distributed equally among all the inhabitants of the globe, from the Eskimo in his frozen igloo, to the African bushman in his grass hovel, there would be forty-four dollars to give to every man, woman and child. The world's population is estimated at more than a billion and a half souls. Or, a man could ride in a taxi to the sun and back, paying fifty cents a mile for the trip, and have about sixteen million dollars left.

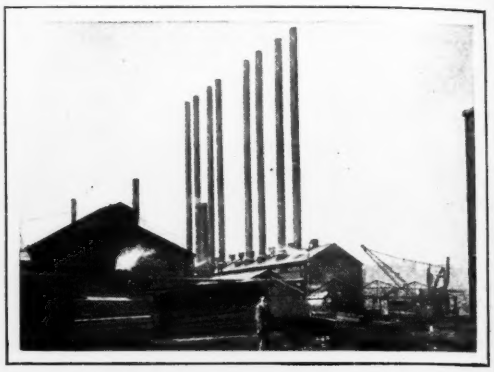
The Money That Goes Up the Chimney

What smoke costs the cities of the world

Illustrations by Bureau of Smoke Regulations of the City of Pittsburgh



Smoke issuing from the plant of a great steel company. This was a daily occurrence



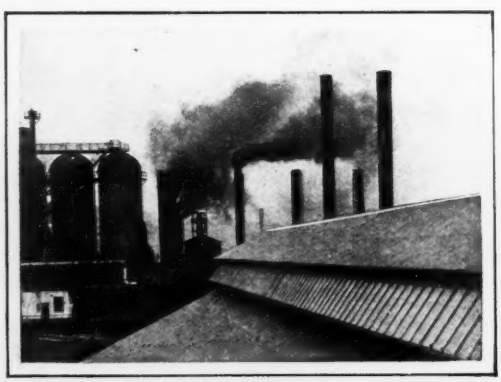
The same plant as it looks today after strict adherence to smoke-abatement ordinances

"THERE was a time," said the great German chemist, Dr. Otto N. Witt, in the course of an address a few years ago, "when smoke was considered a necessary evil, which had to be endured. After a while smoke began to be looked upon as a nuisance, and war was declared against it by those who suffered from its disagreeable properties; but now we know that smoke is a waste, and that nobody has better cause to wage war against it than the man who produces it.

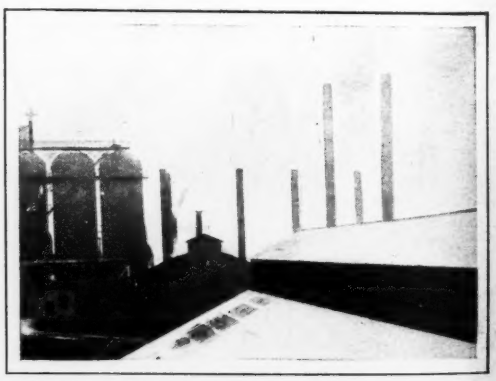
"Smoking chimneys are thieves, and their misdeeds should not rise unavenged to Heaven. It is, perhaps, not too much to say that the saving of national wealth effected by regenerative gas heating may amount to a sum sufficient to pay the aggregate national debts of all civilized nations." With the cost of the nuisance thus emphasized the producer grows thoughtful.

The smoke problem is no novelty. The smoke of London was a cause of complaint in the Middle Ages, and a man was executed in that city early in the fourteenth century for burning "sea coal." The first smoke-abatement invention was patented by James Watt in 1785.

In recent times the war against smoke has been carried on by numerous societies in Europe and America; it has included the adoption of a great many laws and ordinances, which, for one reason or another, have not generally been effective; it has been the occasion of international conferences and national expositions; and its literature is so voluminous that an incomplete list of the books and papers on the subject, published by the Mellon Institute, of Pittsburgh, Pa., fills 164 pages. The facts and figures adduced in the arraignment of this evil are stupendous. It has been said, for example, to



Dense smoke issuing from the numerous stacks before air was admitted above the arches

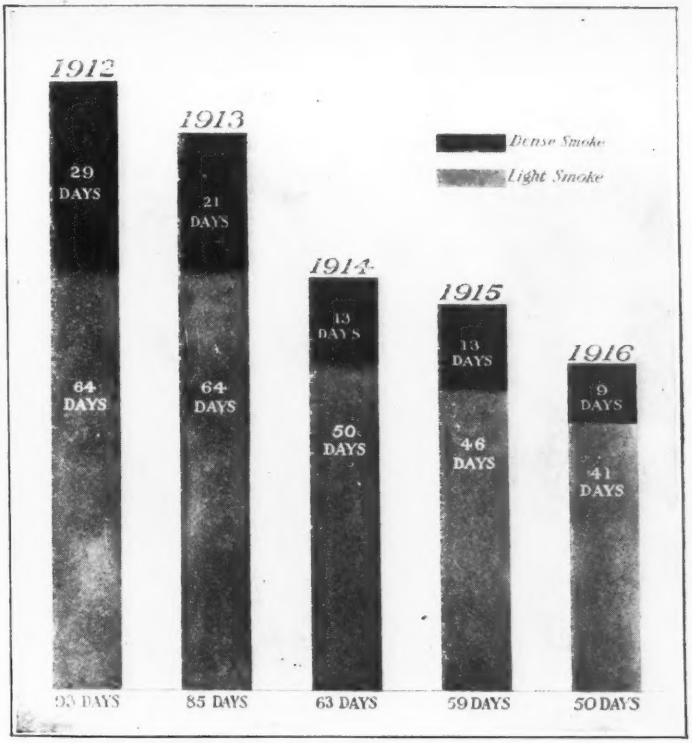


The same plant after arrangements were made for the admission of a regulated air supply

cause an annual waste and damage of half a billion dollars in this country alone. Yet dollars—not to mention health—continue to go up in smoke.

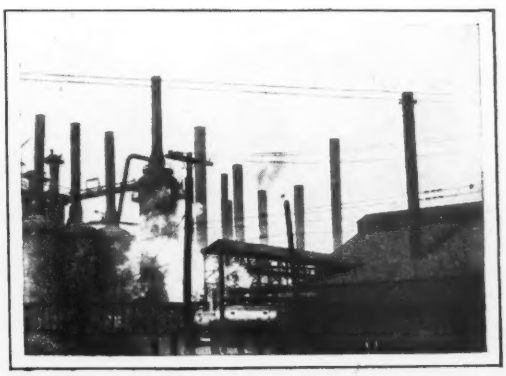
Pittsburgh's Record of Smoky Extravagance

Things are improving, however; partly owing to the increased use of gas and electricity in place of coal, and partly to better appliances for burning coal. Pittsburgh furnishes an example not only of the smoke evil at its worst, but also of what may be done to mitigate it. Exhaustive studies of the subject were made in that city by the Mellon Institute of Industrial Research. According to data published in that connection the smoke evil was then costing Pittsburgh $9,944,740 per annum, not including depreciation in the value of property, absence of various industries which cannot flourish in a smoky atmosphere, and injury to human health. The smoke makers themselves were losing $1,520,740, which might have been saved by more perfect combustion of fuel. The laundry bills of the people of Pittsburgh were $1,500,000 bigger than they would have been with a clean atmosphere, and their dry cleaning bills $750,000 bigger. Yet the city has a large population of unskilled laborers who have little use for laundries, and light-colored clothing is such a rarity in Pittsburgh that the city has been called "the mourning town." Houses in Pittsburgh were, on an average, painted every three years, as compared with every six or eight years in other cities. The sheet metal of roofs, gutters, spouts, etc., deteriorated twice as fast in the smoky atmosphere of Pittsburgh as in an average large city, and needed painting twice as often. Pittsburgh



The smoke abatement results in Pittsburgh for the first months of the years 1912 to 1916 inclusive, as contained in the United States weather reports. Until three years ago the smoke evil was costing Pittsburgh ten million dollars annually

Smoke generated with part of the plant idle. On a busy day it seemed a veritable volcano

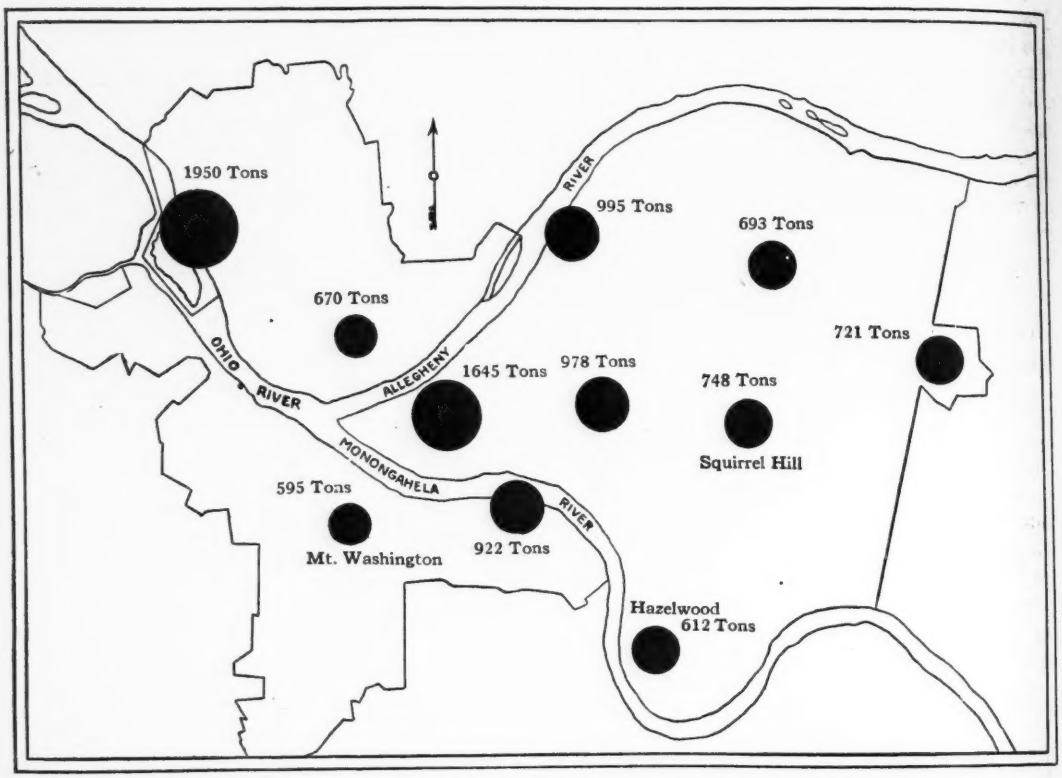


The plant as it looks today, with every furnace working. Smoke is hardly noticeable

is the only city where people habitually have their wall paper cleaned once or twice a year by a professional cleaner. The city was spending more than $730,000 for artificial light in the daytime.

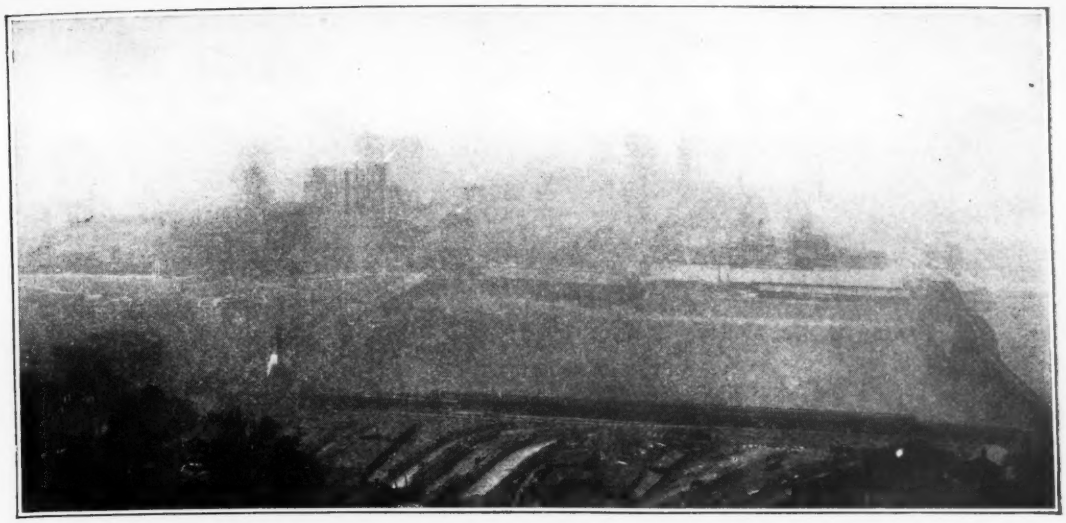
Stringent smoke-abatement ordinances were adopted in 1914, and in the following year it was reported that the amount of smoke emitted had been reduced 75 per cent. Pittsburgh has a Smoke Bureau, which costs the city $11,000 per annum, and which now effects an annual saving to the community of several million dollars. The methods adopted to diminish the smoke include changes to gas, coke and low-volatile coals, installation of down-draft boilers, inclined chain-grate stokers, underfeed stokers, steam jets and extension stacks.

Another city in which elaborate investigations have been made is Chicago. Dr. W. F. M. Goss, of the University of Illinois, who directed these studies, brought out several interesting facts, one of which is that too much importance has generally been attached to the mere visibility of smoke. Thus many American cities prohibit "dense smoke," or "black, thick and continuous smoke," or smoke intercepting a certain percentage of light. But it appears that while the adoption of anthracite coal or coke as fuel will render the discharge of smoke less visible, it will not materially reduce the emission of dust or fine cinder. Another important point brought out by the Chicago investigations is the extent to which the atmosphere of a great city is polluted by forms of dust not due to smoke.



Pittsburgh's sootfall map. To determine the amount of solid matter or soot in the atmosphere, its distribution and composition, stations were selected in various parts of the city. The weight of the sootfall in grams at each station for each month was calculated. Pittsburgh's annual sootfall was found to be 1,031 tons per square mile. That of Leeds, England, is from 26 to 539 tons

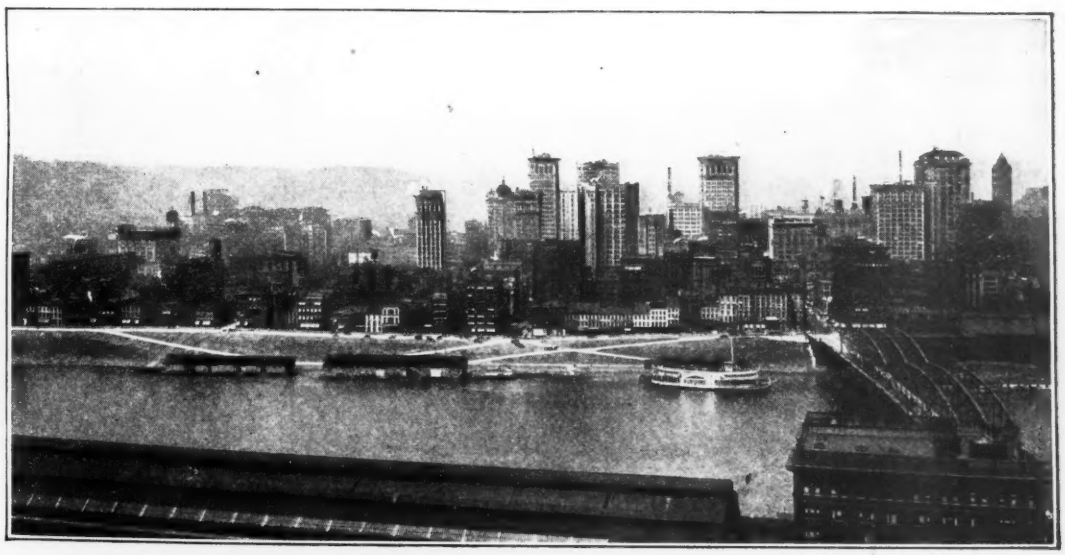
Exact measurements of the amount of solid matter contributed to the atmosphere by smoke have been made more extensively in Europe than in America. Measurements of sootfall made at twelve stations in Pittsburgh in 1912-13 indicated an annual average deposit of soot in that city amounting to 1,031 tons per square mile. In Leeds, England, the sootfall ranges from 26 to 539 tons per square mile in different sections of the town. London's average is 248 tons for the whole city and 426 tons in the central districts. In the center of Glasgow



Pittsburgh on a smoky day. The Mellon Institute investigations showed that smoke had a depressing effect upon the minds of many people. It also had a marked effect on health

the annual deposit during 1910-11 was 820 tons per square mile.

In Great Britain the recently formed Committee for the Investigation of Atmospheric Pollution has installed standard measuring apparatus in sixteen English and Scotch towns. In some cases there are as many as ten stations in a single town. The organization is analogous to a meteorological service, with its network of stations for observing the weather. The standard collector, or "pollution gage," consists of a large cast-iron funnel, enameled on the inside, having a collecting area of four square feet. Projecting above the gage is a wire screen, open at the top, intended to prevent birds from settling on the edge of the vessel. The gage communicates at the bottom by a tube with one or more bottles for collecting rain-water, with its solid contents. The bottles are emptied once a month and their contents analyzed. Thus information is obtained not only as to the total monthly deposit of soot and dust, but as to its chemical composition. The intensity of sunlight is also measured.



The same view as above, photographed when Pittsburgh was rid of the smoke evil. The city now saves more than a million dollars annually on its lighting, laundry, and cleaning bills

An old State of Washington pioneer hollowed out this huge tree stump to make a dwelling. Now it serves as a bandstand

A Tree That Served as a Home Is Now a Bandstand

A PIONEER homesteader in the State of Washington utilized a partly hollowed tree for a dwelling. He cut off the top, thus leaving the huge cedar stump. This he completely hollowed to the roomy dimensions of ten feet square, a palatial abode for the locality and the times. The tree itself is fifteen feet in diameter.

When the old man no longer needed this shelter it was removed to the Seattle Exposition in 1909, as a curiosity, and at the close of the exposition it was purchased and presented to the city of Tacoma and placed in the city park. A railing was built around the top of the stump to make a platform for band concerts or public speaking. A band of no less than thirty instruments has been accommodated on it. The interior is fitted with table and chairs for picnickers.

Plants Like Animals Need Lime for Subsistence

MOST gardens would grow better if they were given a moderate quantity of slaked lime. Without the proper quantity of lime in the soil, a garden cannot grow hardy vegetables of maximum size. The spreading of very thin layers of the slaked lime during the fall would help considerably. The winter snows and rains would wash it down into the soil so that it would be fully incorporated with it. A half pound of lime should be used for every fifty square feet of lawn or garden.

Ball Throwing with a Sling

THE age-old sling has been put on a modern basis by Warren W. Wooster, of New Jersey. A wire clutch in a cup at the end of a pole holds a ball while the pole is swung about the head. A trigger on the handle of the pole is connected with the clutch to release the ball at the proper instant. The ball flies off from the pole toward the target at an enormous speed.

The pole is hollow and contains a sliding rod inside to connect the trigger with the clutch. The ball is placed in the clutch when the rod is moved out furthest from the handle. Then the elastic wire arms which make up the clutch will be above the top of the cup and will spring open to receive the ball. When the ball is pressed down into the cup, the rod is pushed into the handle, and the trigger engages a collar and holds the rod in place. The handle is grasped with the trigger in the rear. It is whirled about the head and the trigger is pressed at the proper moment. A strong spring at the bottom of the clutch causes the clutch to spring out, and the ball flies off towards the target.

When using this device the boy stands twice as far away from the target as he would if throwing from the hand alone.

The wire arms hold the ball while the handle is whirled about the head

Prospecting the Skies

More discoveries in astronomy are now made in a single night than all the earlier astronomers made collectively

By Dr. C. Furness

Professor of Astronomy in Vassar College

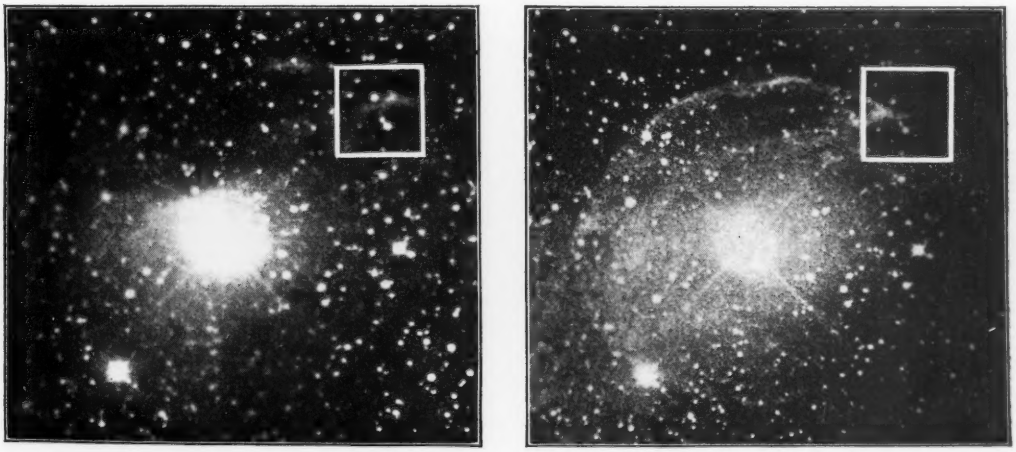
Comet-seeking telescope attached to observation chair

WITH only our eyes to help us, we would know no more about the stars than did the ancient Greeks. What we need is an artificial eye—something to be placed in front of our own, something which, by gathering the light reflected from distant bodies, brings those bodies miraculously nearer to us. Because Galileo was the first to employ such artificial aid in astronomy, he still lives in the popular mind as the greatest of all astronomers. It is indeed wonderful what Galileo actually succeeded in discovering with his artificial eye—a telescope which had lenses no bigger than those of a pair of spectacles. But the discoveries—using the word in its broadest sense—made by the modern astronomer are in every way as startling, in every way as important as those it was the privilege of the great Italian to record. If the modern astronomer's explorations are not so well-known, it is because they are so extraordinarily numerous, and because they have lost in consequence something in dramatic novelty. Only a revelation of unprecedented importance receives attention in the newspapers.

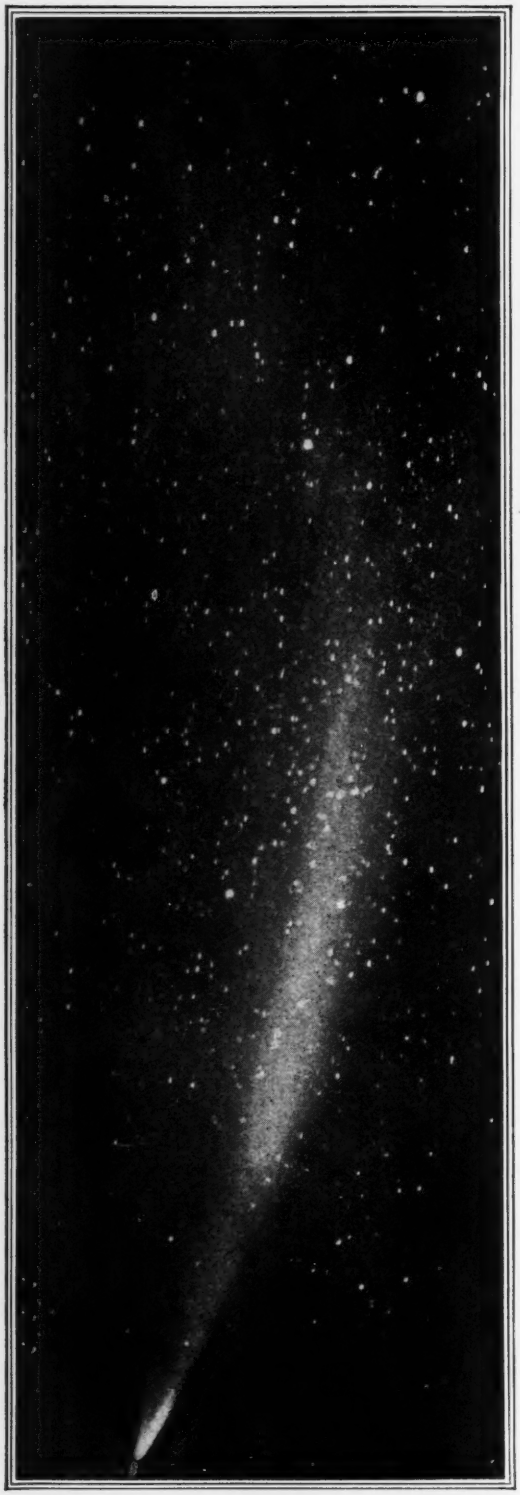
Astronomers Have Become Specialists

The artificial eyes that we call telescopes have gained wonderfully in power since Galileo's day. They are used more systematically, too. Astronomers have become specialists. Some of them confine their studies to comets; others, to the planets; still others to the sun. And there are many who hardly ever look through a telescope at all, but who simply measure the positions of stars on photographic plates.

To show just how one of these specialists goes to work, let me ask you to consider the procedure of the comet-seeker. Comets usually reach their greatest brightness when they are nearest the sun, at which



Change in the nebulosity about Nova Persei, the brilliant new star discovered in 1901. Long exposure photographs showed the star to be enveloped by an extensive nebula. A second exposure taken weeks later showed that the nebula had expanded outward. Comparison of the portion in the white squares with reference to the three largest stars gives an idea of this expansion



The great comet discovered January, 1910. The photograph was taken at the Lowell Observatory, Flagstaff, Arizona, two weeks after its first appearance in the south

time they rise just before it, or set just after it. In the former case they could be detected by an observer who looks toward the east in the early dawn; in the latter they must be sought for in the west soon after sunset. Often use is made of a telescope especially designed for this purpose, which is called a "comet-seeker." It can be moved both in a vertical and a horizontal direction. It is set first at some convenient low altitude, and swung slowly parallel to the horizon as far as the observer wishes to extend his search, say 45 degrees on either side of the sunset point. After he has swept carefully from end to end of this arc, he sets his instrument at a slightly different angle and slowly swings it back. This slow swinging back and forth gives to the operation its name.

Brooks—Discoverer of Twenty-Seven Comets

Such a systematic search is sure to bring rewards in the end. Dr. William Brooks, Director of the Smith Observatory, Geneva, New York, and Professor of Astronomy at Hobart and William Smith Colleges, has to his credit twenty-seven comets. In a letter to the writer he says that this is only one less than the greatest number ascribed to any single astronomer. Pons, a French astronomer who died in 1831, discovered twenty-eight, and Dr. Brooks is ambitious to add two more to his list.

Most comets come from apparently nowhere and leave us again, never to return. How do we know? An astronomer has only to note the position of a comet on three separate nights in order to obtain three points in the orbit of the comet. After having computed the orbit with the aid of these points he sees whether or not that orbit is an open curve, like a parabola or an hyperbola, or a closed curve like an ellipse. Only the comets that revolve around the sun in an ellipse are ever seen again. They are called "periodic comets" because their return can be accurately predicted.

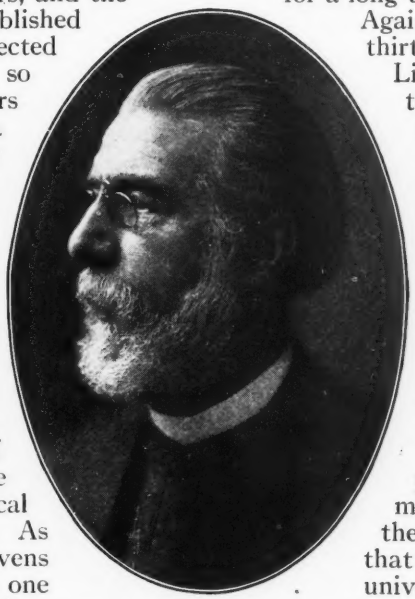
Halley's Famous Comet

Most interesting of all periodic comets is that of Halley, named after the famous astronomer who was the first to compute its orbit. The last return of Halley's comet was such an important event among astronomers that a prize was offered for the best computation of its orbit. Because of the great number of varying factors

entering into this problem, the task was not easy, but it was finally accomplished by two English astronomers, and the predicted positions were published far in advance of the expected appearance of the comet, so as to enable the astronomers to secure its image on a photographic plate as early as possible. The accompanying illustration shows it as found on negatives taken at the Yerkes Observatory in 1909. In appearance it does not differ markedly from the stars on the plate. It was its change in position which led to its detection.

Calculating the orbit of Halley's comet is one of the most difficult mathematical problems in all astronomy. As it rushes through the heavens the comet is attracted by one planet and repelled by another. Constantly subjected to various forces difficult to appraise, the prediction of its return is well worth a prize. The search for comets is so persistent that most of them are discovered while still faint telescopic objects. One, however, seen during the past few years, the great comet of January, 1910, came toward us from behind the sun in such a way that when first seen it was already a very bright object. Though it was a morning comet, and visible only in southern latitudes, it was so conspicuous that it was discovered independently by several people. Our photograph of it shows it as seen two weeks later at the Lowell Observatory, Flagstaff, Arizona, by which time it had swung around to the other side of the sun.

The comet-seeker finds his counterpart in the satellite hunter. Many of the planets have moons. Galileo himself discovered four of Jupiter's with the little telescope that he devised. In 1877, shortly after the 26-inch instrument of the United States Naval Observatory was put in place, Professor Asaph Hall made a long and persistent search for satellites of Mars. He was just on the point of giving up, continuing one night longer only because his wife urged him, when to their great joy the discovery was made. These two tiny bodies, being very close to their primary, defied detection for a long time.

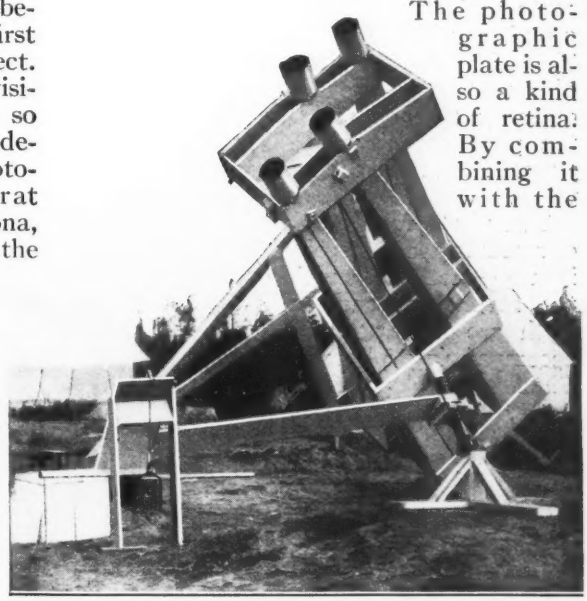


Dr. William R. Brooks, Director of Smith Observatory and Professor of Astronomy of two colleges

Again, in 1892, while the great thirty-six-inch telescope of the Lick Observatory was young to the astronomical world, Professor Barnard determined to find out if the planet Jupiter had any other satellites than the four seen by Galileo with the first telescope ever pointed toward the heavens. He was rewarded by the discovery of the fifth satellite.

The Aid the Camera Gives

There are limits to the possibilities of even the most powerful telescope; but there are no limits to the things that can be discovered in the universe. Artificial eyes had to be improved. That was done, not so much by making telescopes bigger, as by using them in connection with the photographic plate. In the back of your eye is a very sensitive surface called the retina upon which images of the outer world are thrown. You really see with your retina. The photographic plate is also a kind of retina. By combining it with the



Intra-mercurial cameras mounted at Cartright, Labrador, at the time of the total eclipse of August 30, 1905, by the Crocker eclipse expedition

A group of women at the Harvard College Observatory, whose duty it is to study the photographs and record them

telescope an instrument is created which is almost the exact optical equivalent of the human eye.

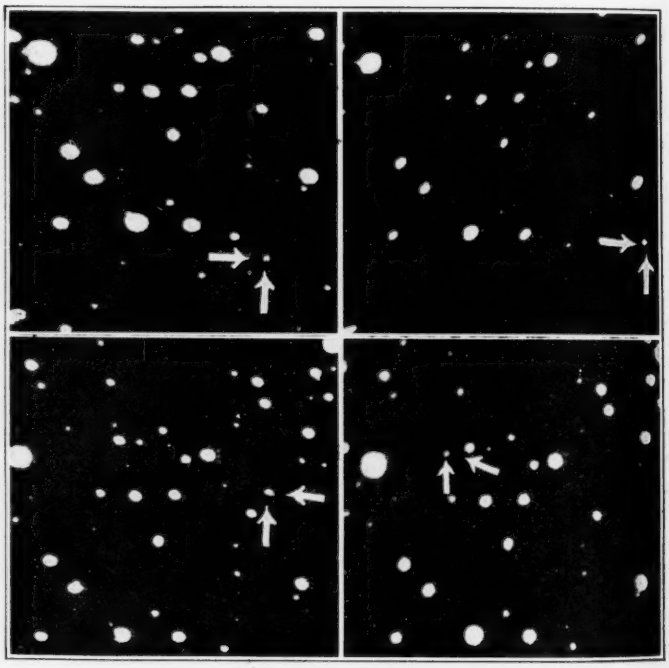
Thanks to this combination of the photographic plate and the telescope, the field of astronomical exploration has been almost immeasurably broadened. It is often literally possible to discover things without actually seeing them.

Among the planets there is a group of very tiny faint bodies which are known as asteroids. Because of their very great number, only the approximate orbits have been computed for most of them. This fact alone makes it difficult to find them on an ordinary star chart. Here, the photographic plate has proved itself to be of immense value.

Two photographic methods of searching for asteroids are in use—methods which are the reverse of each other. Both are illustrated in the accompanying photographs. The first, employed for many years, is based on the fact that asteroids can be detected by their movements among the stars. Ordinarily, when a telescope is used for photographing the heavens, it is connected with clockwork which carries it just as fast as the skies revolve, so that the stars remain fixed in the field of view and appear on the photographic plate as round, sharp images. If, on the other hand, there is present a body which is moving among the stars, it will produce a trail on the plate instead of a round dot. An asteroid is just such a moving body. Therefore it can be recognized by the trail which it leaves and be made an object of further study. Many of the smaller ones, however, make trails which are too faint to be detected in this way. An ingenious method of overcoming the difficulty has been devised by Rev. Joel Metcalf, of Winchester, Mass. He computed in advance what the average motion would be of an asteroid in the particular part of the sky opposite to the sun at any desired time, and gave to his telescope a motion equal in amount but opposite in direction. As a result, the asteroid produced a round dot on the plate, while the stars left trails.

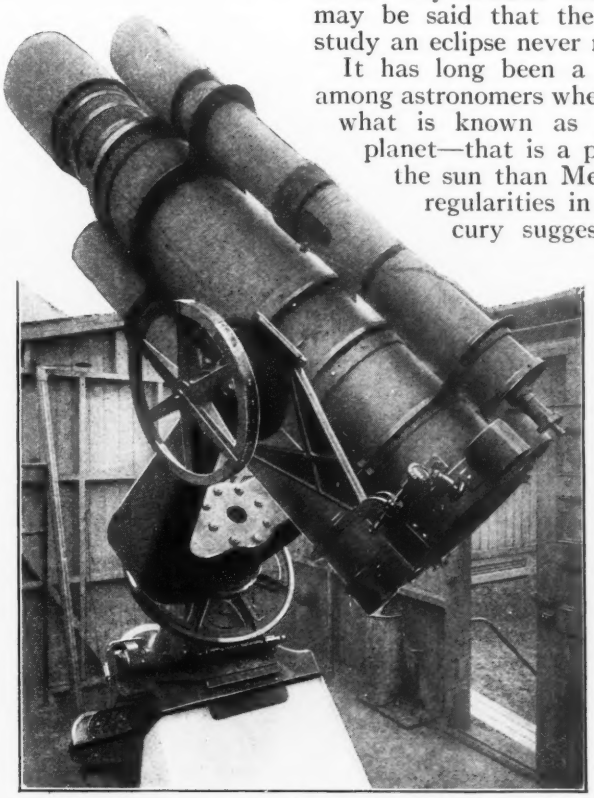
Discovering the Events of Yesterday

Because the photographic plate is not only extraordinarily sensitive, but also



Early photographs of Halley's Comet which were taken at the Yerkes Observatory in 1909. It appears on the photographic plate as a star of the seventeenth magnitude

makes records of what it sees, the astronomer works independently of time, to a certain extent. By examining his photographic plates, he sometimes makes discoveries of phenomena that actually took place years ago. But he must compare new photographs with old, as a general rule. Since Professor Barnard discovered the fifth satellite of Jupiter, no moons have been discovered with the eye, but several have been detected on photographic plates exposed at wide intervals apart. Thus, by comparing two plates on which Saturn has been photographed at different intervals, Professor William H. Pickering in 1898 found a ninth satellite of Saturn. Since then a tenth satellite has been found for Saturn and four new ones for Jupiter—all on photographic plates.



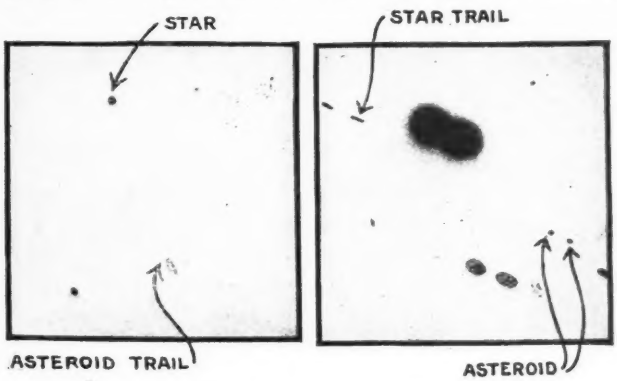
The sixteen-inch Metcalf telescope of the Harvard College Observatory, showing an ordinary photographic telescope attached to a visual telescope for following and measuring the movement of asteroids

Similarly, photography has proved an invaluable aid during solar eclipses. A total eclipse of the sun never lasts more than seven minutes, and usually much less. So short is the time for observation that each of the astronomers who constitute an eclipse expedition has his specific task during the few precious minutes allotted to him. Some of the men never even look up at the sky; others carefully examine certain parts of the sky around the sun. Indeed, it may be said that the astronomers who study an eclipse never really see it.

It has long been a subject of debate among astronomers whether or not there is what is known as an intra-mercurial planet—that is a planet much nearer the sun than Mercury. Certain irregularities in the orbit of Mercury suggest that perhaps it may be influenced by some such body. Mercury itself can be seen only at favorable times because of its nearness to the dazzlingly bright sun. An intra-mercurial planet, if it existed, could be seen only during the darkness of a total eclipse. Hence it is part of the duty of every eclipse expedition to search for an intra-mercurial planet. Nowadays this is done photographically.

The apparatus employed consists of a battery of cameras mounted together and pointed so that they cover the region of the sky immediately surrounding the sun. Any object of ordinary size would have been recorded by them, as the search has been carried on during several recent eclipses, but none has yet appeared.

Sometimes the photographic plate reveals phenomena that astonish even practiced astronomers.



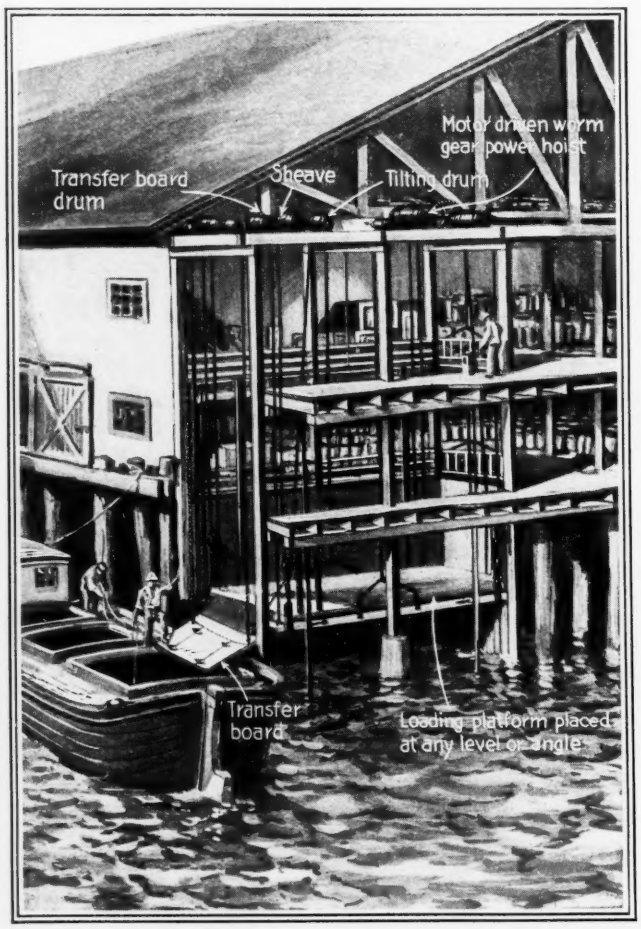
Through the ordinary telescope the star appears as a dot and the asteroid as a dash. Through the Metcalf instrument this is reversed as in picture on right

In 1901, for example, there appeared the brilliant new star Nova Persei. Long exposure photographs showed that the star was enveloped by an extensive and beautiful nebula. That was in itself not remarkable. But a second exposure made several weeks later showed that the shape of the nebula had changed and that it had expanded outward. Astronomers were bewildered. The star is so very distant from us that it takes its light centuries to reach us. We saw it on the plates, not as it appeared when the exposures were made, but as it appeared long before the steam engine was invented, long before there were railroads. Obviously, the real distance in miles traveled by this expanding portion of the nebula must have been enormous. Attempt after attempt was made to explain this apparently incredible phenomenon; but nothing really satisfactory has yet been suggested.

Far less dramatic, but of immense value, is the photographic work done at Harvard in mapping the sky. The map is not made once for all, but its separate sections are constantly rephotographed. The plates are stored in a fireproof building erected especially for the purpose. With such a photographic record, it becomes possible to study the past history of a star at any time. The study of these photographs constitutes a very important part of the work, which is done mostly by women.

Freighting a Steamer by Means of a Marine Elevator

A MARINE elevator which enables a vessel to be loaded at any time or tide, which doubles the normal rate of the loading and which reduces expenses a corresponding amount is now being introduced all along our coasts. Formerly a coast steamer had to wait for the tide to come in before she could steam up to the loading dock. Then the cargo was either hauled up by the ship's derricks piece by piece, or it was run up the gangway by the truck load. But with the elevator designed by Harry Barlow, of Seattle, Washington, an entire platform of material can be quickly carried up to the vessel's deck at once. And if the tide is out, the light sound boat carrying the elevator steams from the dock to the vessel anchored near by.



The platform of the elevator is brought to the level of the dock where it is quickly loaded. An electric motor then hoists it to the deck of the steamer

A small electric motor mounted on the top of the elevator structure furnishes the power for the half dozen cables used. The motor controls are placed at any point that affords the operator an unobstructed view. After the operator has brought the platform to the level of the loading dock, the filled platform can be easily raised up to the deck of the largest steamer. Level trucking is thus afforded in place of trucking up or down steeply inclined gangways. This fact makes the elevator indispensable for loading explosives or fragile wares.

An Improvised Tree Sprayer and Fire Engine Combined

AT World's End Farm, owned by Mrs. W. W. Blackmar, and situated at Hingham, Massachusetts, are many interesting contrivances. Among them is a tank on wheels, used as a fire engine and sprayer combined.

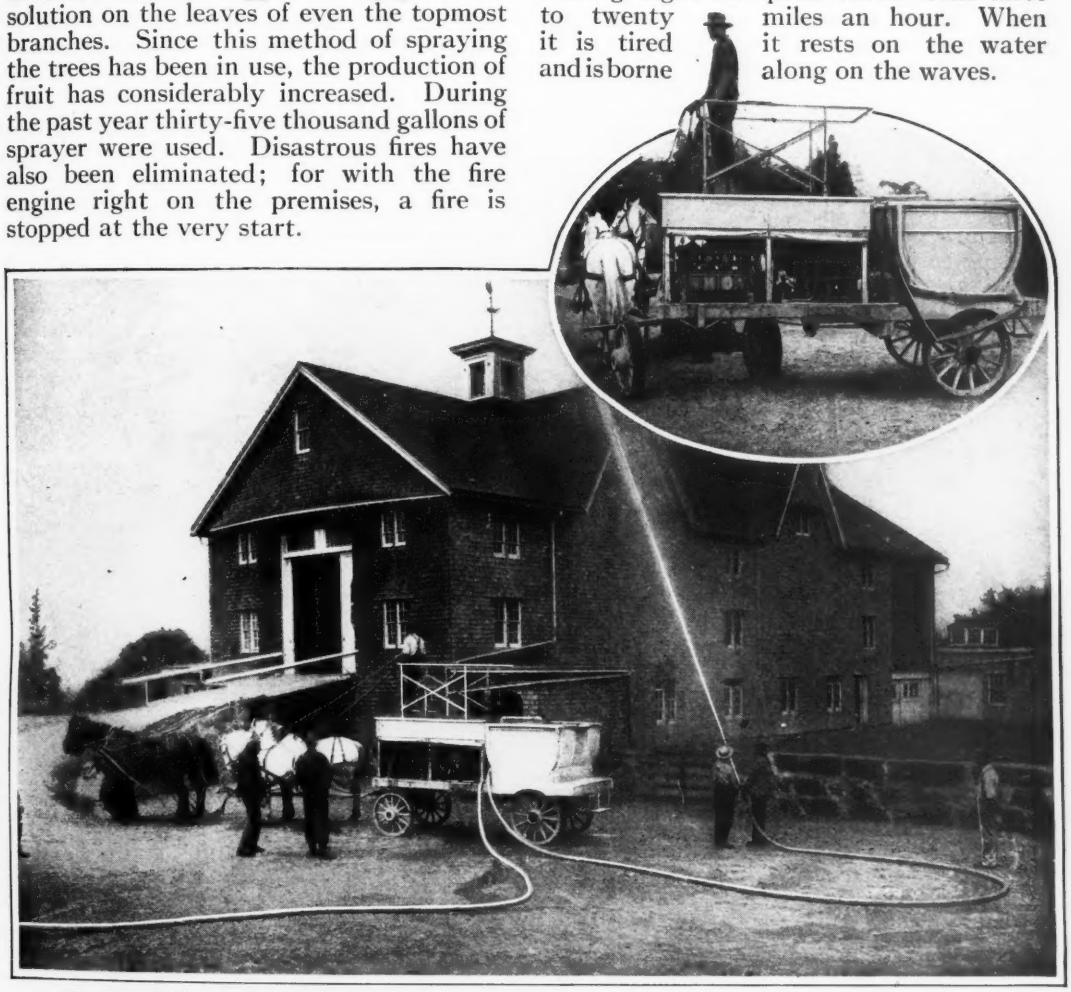
An old twenty-five horsepower automobile engine is mounted on a wagon-truck together with a pump and a four hundred and sixty gallon tank. The entire weight is nine thousand, five hundred pounds.

The contrivance was improvised by Mr. C. R. Goodhue, the superintendent of the grounds. It is used for spraying trees, and, in cases of emergency, to put out fires. It throws a spray eighty feet in the air with sufficient force to completely clean the trees of insects and their eggs, leaving germicide solution on the leaves of even the topmost branches. Since this method of spraying the trees has been in use, the production of fruit has considerably increased. During the past year thirty-five thousand gallons of sprayer were used. Disastrous fires have also been eliminated; for with the fire engine right on the premises, a fire is stopped at the very start.

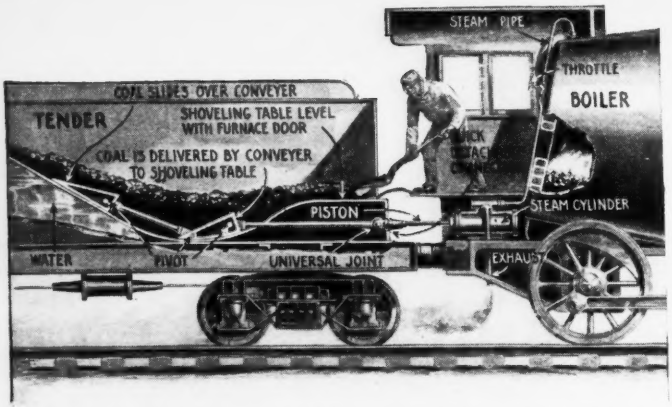
Grasshoppers Which Fly a Thousand Miles Out at Sea

THE grasshopper would seem to have nothing in common with the seagull, yet grasshoppers have been picked up in swarms at sea, 1,200 miles from the nearest land.

The African grasshopper has been known to cross the Red and Mediterranean seas in destructive numbers and even to fly to the Canary Islands. For the most part these grasshoppers are of a migratory species (*Schistocera tartarica*) noted for its great flights. The bodies are about four inches long and are equipped with large air sacs in addition to the usual breathing tubes. These sacs buoy up the insect so that it is able to stay in the air for days at a time, exerting practically no effort at all. During flight its speed varies from three to twenty miles an hour. When it is tired it rests on the water and is borne along on the waves.



The tree-sprayer fire engine throws a stream eighty feet into the air. For the more strenuous fire-engine duties large open nozzles are used instead of the ordinary spraying nozzles



An inclined rear wall on the tender allows the coal to slide steadily down to a point in front of the vibrating pushers

Supplying Coal to the Engine by Means of Vibrating Pushers

WHEN the coal bin of a locomotive is full there is but a step between the fireman and the supply, but as the great iron horse eats back its food supply there is another step and then another, until firing partakes of the nature of a Marathon race. How to get the coal to the firemen in a big modern locomotive is a problem to which inventors have been giving their attention.

Strictly speaking, the device which is illustrated and which is intended to solve this problem is a vibrator rather than a conveyer, for the coal is not carried from point to point in a receptacle but is shoved by a vibrating pusher, which then recedes, allowing more coal to drop in front of it, and then pushing that onward, the movement being transmitted to the fuel in front. The pushers are actuated by a reciprocating piston, suitably governed, and preferably situated in the engine proper, but with such readily detachable connections that the tender can be disconnected from the locomotive when desired.

The mechanism is controlled by a lever, which regulates a throttle in the steam connection with the vibrating piston and cylinder and which is under the direct management of the fireman. Other forms of motive power can be used with the apparatus. The side walls may be made to slope toward the center with advantage, for gravity is a cheap force and should be made use of wherever possible. The pushers extend clear across the bottom of the tender and move the entire lower stratum of coal with each forward stroke of the reciprocating piston. The device is the invention of Charles L. Heisler, of Schenectady, N. Y.

Candling Eggs in the Newest Way Without the Aid of a Dark Room

AS far as the consumer is concerned there are only two kinds of eggs—good ones and bad ones; and usually he cannot distinguish one from the other until he breaks the shell. But to the dealer there are several grades between the best and the unusable eggs. For years these grades have been determined by candling—a process requiring a dark room and a point of light against which the egg is held to get a kind of X-Ray view of its interior. The process is slow and the conditions under which the men must work are more or less unsanitary.

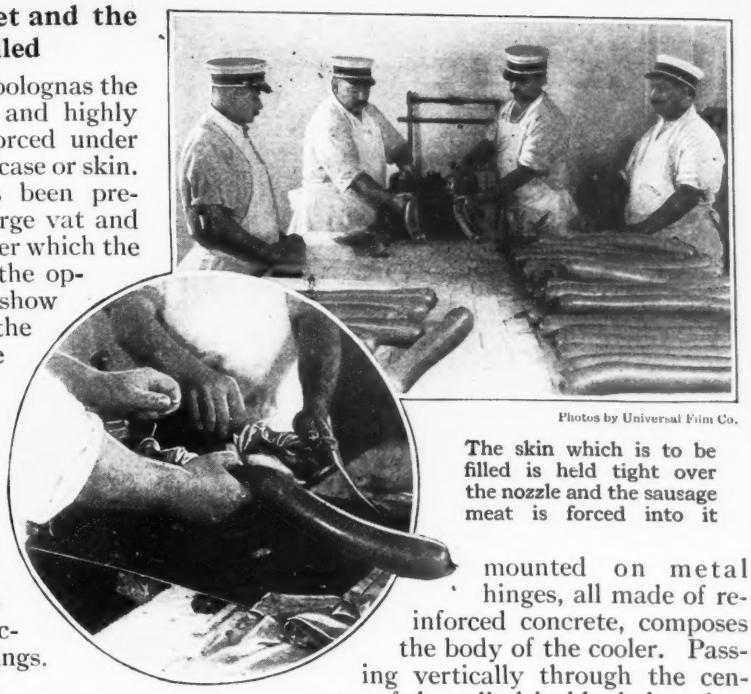
A bulb inside the device throws its light around the egg

A newer method employs the candling device shown in the illustration. This device confines the dark area where it belongs—just around the egg. The projection on top of the device has a slight slant so that it is impossible for any light to get to the egg from above. With this device one room may be used for candling, grading and packing.

Simply Turn the Faucet and the Sausages Are Filled

IN making sausages and bolognas the meat is first chopped and highly seasoned. Then it is forced under pressure into a cylindrical case or skin.

After the sausage has been prepared, it is placed in a large vat and forced through a nozzle over which the skin has been drawn by the operator. The illustrations show how this is done. When the valve is opened the meat rushes into the hollow skin like water from a hydrant into a fire hose, distending the skin and filling it out to capacity. The sausages are then tied and are ready for the market. The preparation of the skins is an elaborate process involving many washings.

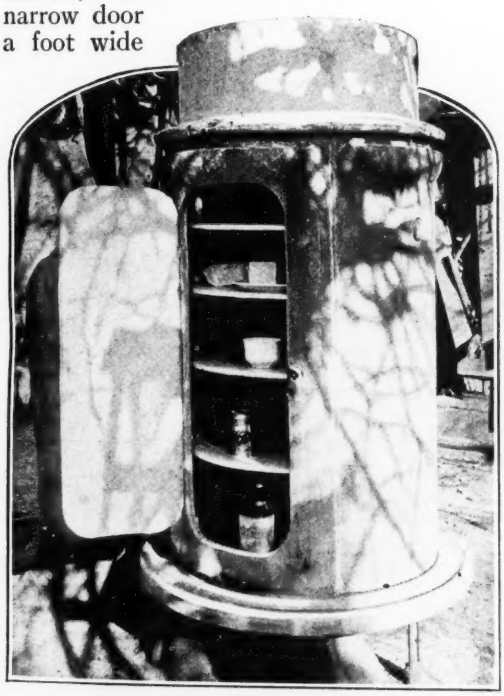


Photos by Universal Film Co.

The skin which is to be filled is held tight over the nozzle and the sausage meat is forced into it

A Concrete Cooler Which Chills by the Action of Evaporating Water

A LARGE cylindrical compartment, five feet in height and three feet in diameter, with a narrow door a foot wide mounted on metal hinges, all made of reinforced concrete, composes the body of the cooler. Passing vertically through the center of the cylindrical body is a piece of metal piping upon which have been constructed, at uniform intervals, five flat, imitation-porcelain disks which serve as shelves. Both the upper and lower ends of the piping rest in cup-shaped sockets so designed that the pipe and its disk-shelves may be readily turned. The shelves may thus be caused to pass before the door opening with the boxes and vessels upon them.

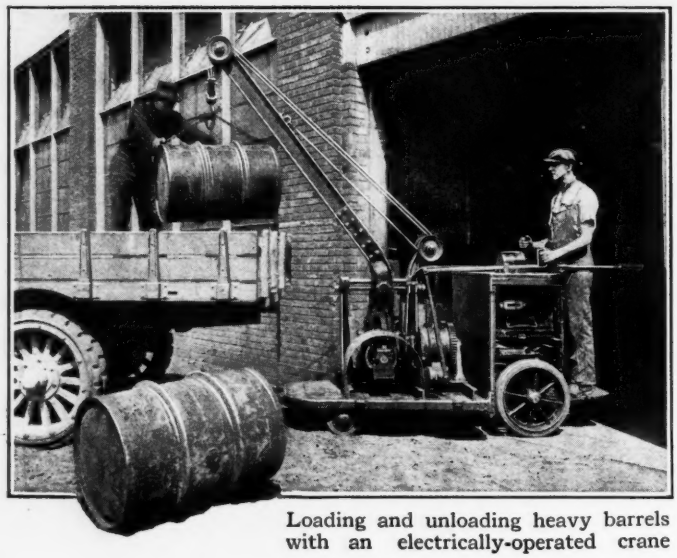


At the top is a concrete reservoir from which the water overflows down the sides of the cooler

To provide proper ventilation, two small holes are cut in the sides of the body near the top, and these are covered on the inside with fine screen wire to keep out insects.

The body is mounted on a flat concrete plate raised about twelve inches off the ground by supports. On the outer edge of the surface of this plate, which extends beyond the sides of the body, a shallow groove has been made to contain a moat of water. This moat forms a barrier to the invasion of ground insects.

The top of the body is surmounted with a concrete reservoir which has to be filled once a day with water. This water finds an escape at the bottom of the reservoir through four small valves which are set diagonally opposite each other. The water from the valves first spills into a small trough surrounding the top of the body and then overflows down the sides. The evaporation of this water as it spreads over the cooler's sides keeps the inside of the cylinder almost as cool as if ice were used.

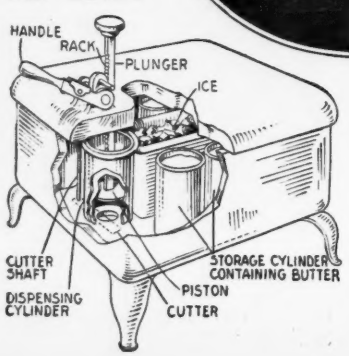


Loading and unloading heavy barrels with an electrically-operated crane

A Pigmy Electric Crane with the Strength of a Giant

TIME is the all-important factor in the delivery system of any large distributing company. That is one reason why motor-trucks have superseded the horse and wagon. But it sometimes happens that more time is consumed in loading or unloading a vehicle than in transporting the material to its destination. Thus there is a persistent demand at present for cranes and lifting machinery which will serve the truck without delay.

The illustration shows a novel type of electric crane employed to load and unload three hundred-pound barrels on a truck. It does its work in one fifth the time required to roll the barrels and lift them on the truck by hand. Another advantage is that the barrels are not damaged or handled roughly in unloading and there is little or no danger from accidents. It requires the services of only two men.



What the Zeppelins Have Cost London in Accidents and Deaths

HOME Secretary Cave, in a recent speech in the House of Commons, gave the total number of fatal accidents in the London streets between sunset and sunrise since the beginning of the war and the total number of persons killed by Zeppelins. According to him the number of fatal accidents in the Metropolitan Police District during the hours of darkness between August 1, 1914, and January 31 last, was nine hundred and fifty-four. The number of persons killed by Zeppelins in the same district was one hundred and thirty-seven. In the city proper there were twenty-nine fatal accidents and thirteen persons killed by Zeppelins.

Serving Individual Portions of Butter by Machinery

AN automatic butter-serving machine, such as is shown in the illustration, will cut and deposit the individual squares of butter on their respective plates in a fraction of the time required by a waiter for the task, and in a manner more satisfactory to the health experts.

There are eight storage cylinders and a compartment for ice

The butter is placed in a cylinder inside the machine, from which it is forced through an opening in the bottom by means of a plunger geared to a handle. A downward throw of the handle moves the plunger the length of a notch. A cutting wire is simultaneously swung into position. The upward throw of the handle reverses the cutter shaft and forces the wire through the butter, thus dividing it into individual portions. These it throws forward on to the plates set to receive them. A separate chamber in the center of the machine is filled with ice to keep the butter at the proper temperature.

Rain When the Farmer Wants It

What an overhead irrigating system has done for a New Jersey farm

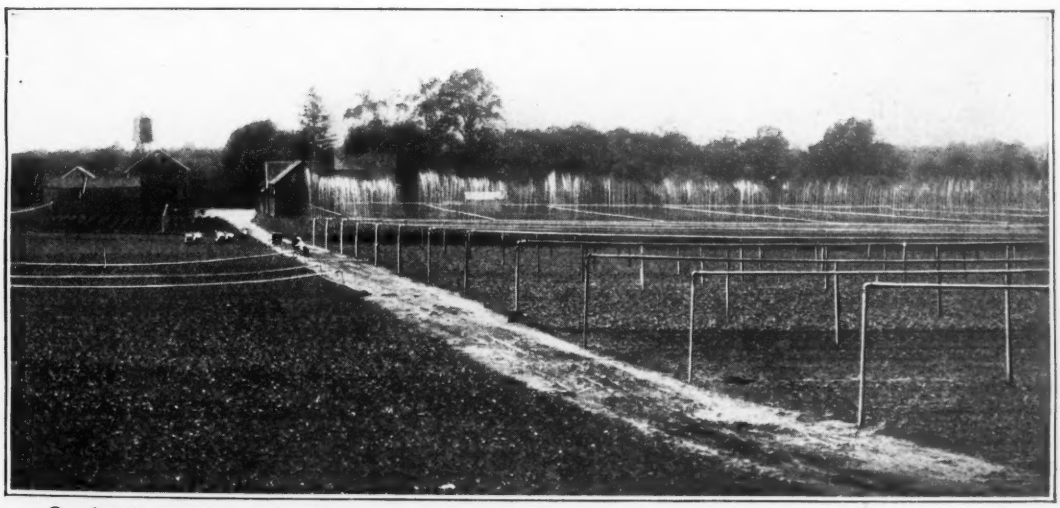
MOST people think farming is a gamble. They have good reason to believe this, because the farmer is dependent on the weather and nothing is more fickle than that. But just the same, one shrewd Jerseyman has found a thoroughly effective way to make his fruitful acres ripen on schedule time and with an amazing bounty—let the rains fall or the sun shine as they will.

Charles F. Seabrook has a farm at Bridgeton, New Jersey, of 273 acres, and nearly half of this area is irrigated so that the thirsty plants may be satisfied in keeping with their lusty growth. No, Mr. Seabrook is not a rainmaker, as the term is ordinarily understood, but he is able to produce beneficent showers at will over an expanse of 110 acres. It is a pipe dream come true. This is literally correct, for he employs an extensive installation of overhead conduits from which the necessary water is sprayed so that it falls like a gentle rain upon the soil. In this he imitates Nature at her best and avoids some of her mistakes.

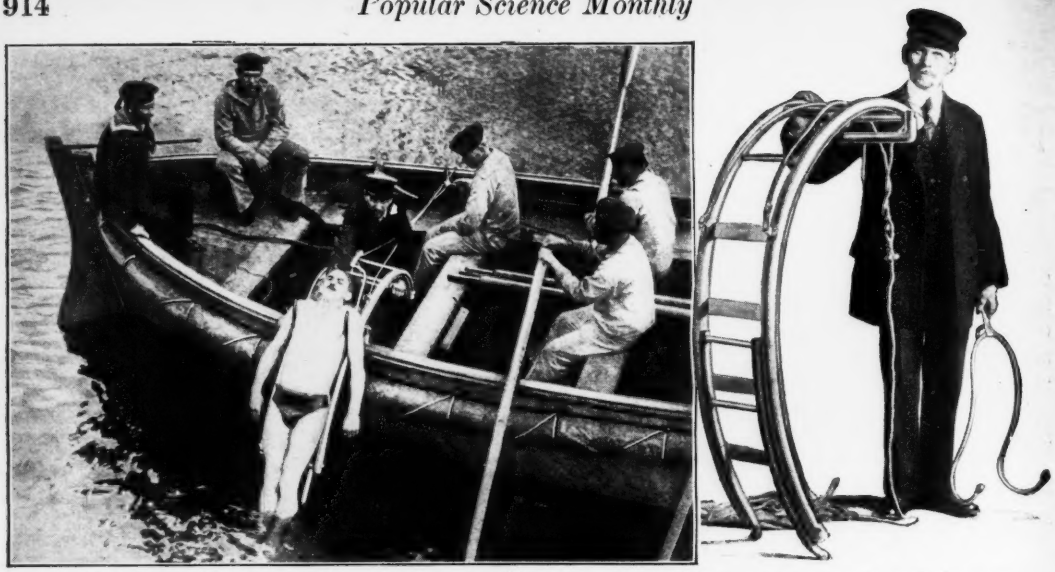
A heavy rain beating down upon the earth packs the surface. Instead of soaking into the ground much of the water remains upon the surface. The sun comes out and dries it up, and at the same time bakes the earth and leaves a hardened crust. Unless this is broken up, but little of the next rain can filter into the earth beneath. The gentle rain artificially produced by the overhead piping does not injure the soil's texture, and wellnigh every drop works its way into the ground and does its share towards stimulating plant growth.

Most of us know little of the part that water plays in the cycle of vegetation, nor do we realize how much water is needed in plant life. For every ton of hay that is cut from the field, five hundred tons of water have been required to bring the grass to maturity! The water works down through the soil dissolving the plant food so that the roots can thus absorb nourishment. From the roots the water passes up through the stalk to the leaves, by which it is exposed to the air, and evaporates. The more vigorous the plant the greater its thirst, and the more abundant the leafing the bigger the demand for moisture lest the circulation fail and the foliage wither in the sun.

In order to promote active growth, Mr. Seabrook fertilizes his soil very richly, and then in order that his growing crops may be nourished abundantly he sees to it that his acres are commensurately irrigated. When Nature is disposed to help he lets her do so, but when she lags he comes to the rescue. Thus his growing crops never lack rain.



Overhead conduits are installed in such a way that practically none of the growing space is interfered with. The water falls in a gentle spray imitating Nature's method at its best



At left above: Rescuing a drowning person with the new boat ladder. One man is sufficient to effect the rescue. At right: The boat ladder telescoped out and ready to be carried overboard

Saving a Drowning Person with an Ingenious Boat Ladder

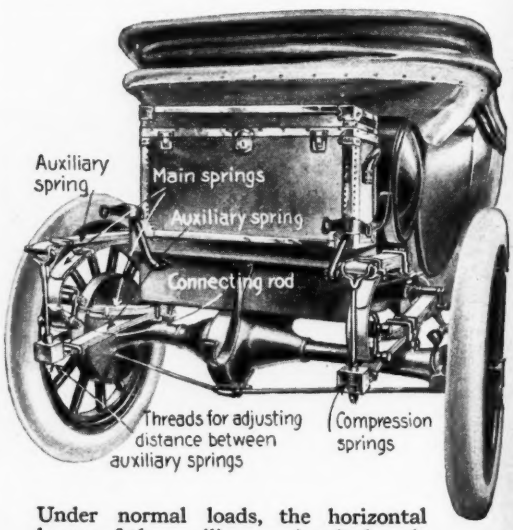
THIS boat ladder, which makes it possible to rescue a drowning person and pull him in the boat without capsizing it, is floated overboard and is attached to the boat by a rope. The man overboard is pulled near to the ladder and placed upon it backward. Then the ladder with its load is pulled into the boat.

The Double Automobile Spring. If One Breaks, the Other Comes into Action

AN automobile is as comfortable and as serviceable as its springs. Should they break, further progress is impossible unless emergency repairs are made. The value of an arrangement which would make such an accident well-nigh impossible is therefore apparent. Clabeorn P. Randolph, of Los Angeles, California, has designed a duplex spring which brings an auxiliary spring into action on the failing of a main spring; it also reinforces a main spring whenever it is overloaded.

It has extra horizontal leaves which project out at the top and bottom of the main spring. These are kept apart by a connecting-rod so that, when the main spring is loaded normally, the auxiliary leaves are kept out of action. The moment the load on the main spring is made greater than normal, however, the extra compression on the main spring will press the auxiliary leaves nearer together, and bring them immediately into action. A weakening or breaking of the main spring would bring about the same result. As soon as the main spring begins to "give," the leaves are again brought nearer together.

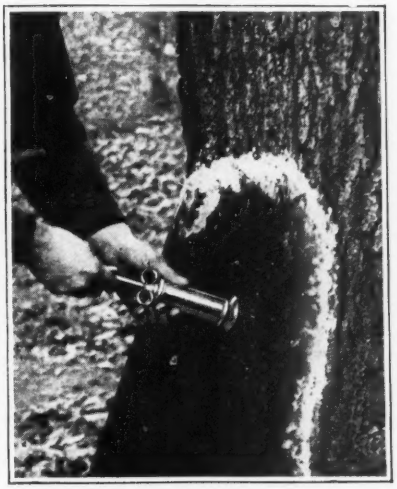
A device of this kind could easily be made to absorb any overstrains on an automobile spring when traveling over rough roads. The connecting rod need only be disconnected from the upper leaves and screwed down into the lower ones so that they are not too far apart. Stresses from the excessive recoils from the roads will then be taken up by the auxiliary spring as well as by the other.



Under normal loads, the horizontal leaves of the auxiliary spring fit loosely above and below the main spring

Killing the Insect Pests of Trees with Poisonous Gas

FUMIGATION is successfully employed by the Forest Service to combat borers and like insect pests that damage shade trees. The fumigating agent used is carbon disulphide, which, in the case of small trees, is injected into the openings by which the borers have entered. The hole then is sealed up with clay and the deadly gas from the chemical eventually makes its way into every cavity, killing all of the pests within its reach. The fumigation process does not injure the tree.



Injecting the chemical in a tree through a roofing-paper shield

Large trees which the pests have entered through decayed places around the base require a certain amount of preparation. The holes in the base of the tree are first covered over with tarred roofing paper, cotton wool being employed to insure as tight a joint as possible. An opening just large enough to admit the end of a syringe is then cut in the paper shield. After a sufficient quantity of the chemical has been injected to insure thorough fumigation, the syringe is withdrawn and the hole sealed up.

The paper is left about the base of the tree until the gases from the chemical have permeated every borer hole and crevice. Then the shields are removed and all of the decayed wood within the opening is cut away. These holes are then filled up with cement. In this way many years are added to the life of a tree, which, otherwise, would have perished in a comparatively short time. The plan has been found to be effective in the cases of trees deemed almost utterly hopeless on account of the number of borers and the extent of their destructive work.

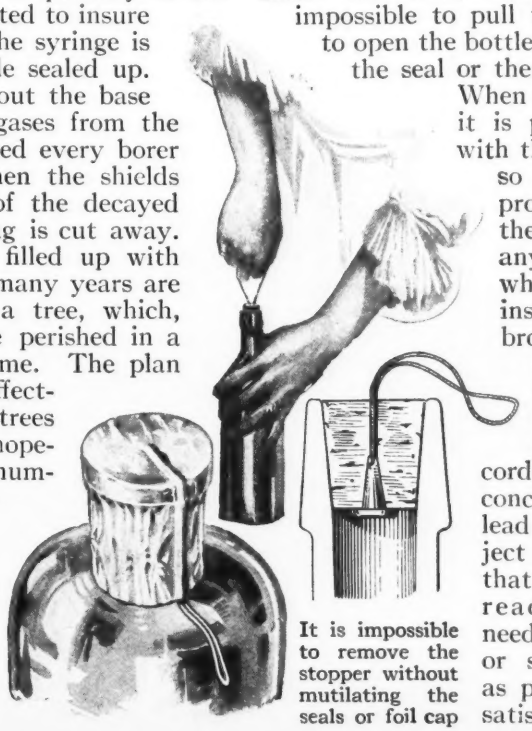
Very shortly after the fumigation and patching-up operations the trees begin to leaf out in newness of life.

This Type of Bottle-Stopper Is a Fraud Detector

AS a means of protection to dealers having an individual trademark and to prevent their bottled goods from being tampered with by the unscrupulous, the bottle-stopper recently invented by James Allen, of Washington, D. C., meets a specific need.

As shown by the illustration it consists of an ordinary tapered cork with a flexible wire or cord passing through the center. At the end of the wire is a plug. The plug has a flanged head. When the wire is pulled the flange strikes the cork so that the plug cannot be pulled out. The cork is used in connection with two protective seals, one seal being wrapped around the neck of the bottle and pasted to it, and the other being secured to the top of the bottle. A part of the pulling cord is held beneath the seal on the top of the bottle and the ends are held down under the other seal. It is therefore impossible to pull the string in order to open the bottle without mutilating the seal or the lead-foil cup.

When this stopper is used it is pushed down flush with the top of the bottle so that no part of it projects. By pulling the cord the seals or any lead foil capsules which may be used instead of seals, are broken through and the stopper removed without a cork screw or other aid. The end of the looped cord may be entirely concealed beneath the lead foil or it may project a little in order that it may be more readily found when needed. Lead-foil caps or seals may be used as preferred, with equal satisfaction.



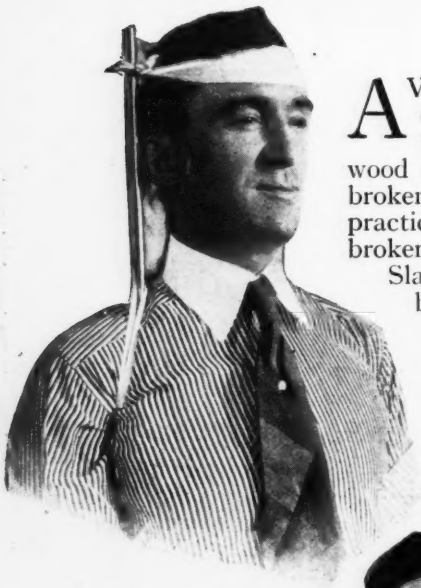
It is impossible to remove the stopper without mutilating the seals or foil cap

A New First Aid to the Fractured

An emergency splint and how it works

A VIRGINIA physician, Dr. Samuel G. Slaughter, has devised an emergency splint by means of which even the unskilled can give first aid. Usually pieces of wood are quickly fashioned into splints which hold the broken member until the doctor arrives. This is a dangerous practice. A splint should conform with the shape of the broken part without straining it in the least. Dr. Slaughter's splint is made of flexible sheet steel which bends to the shape of any part of the body by the mere act of strapping it in place.

Three oblong sheets of thin steel telescope in and out. A number of slits are stamped along their sides. If a leg has been badly broken, all three sections of the splint are used, fully extended. For simple fractures where but one break occurs, the sections can be detached and used separately. In a fracture of the skull the splint is applied opened out nearly flat and fastened in place by tying strips around the forehead and under the arms, while for a fractured arm it takes the shape of a cylinder.

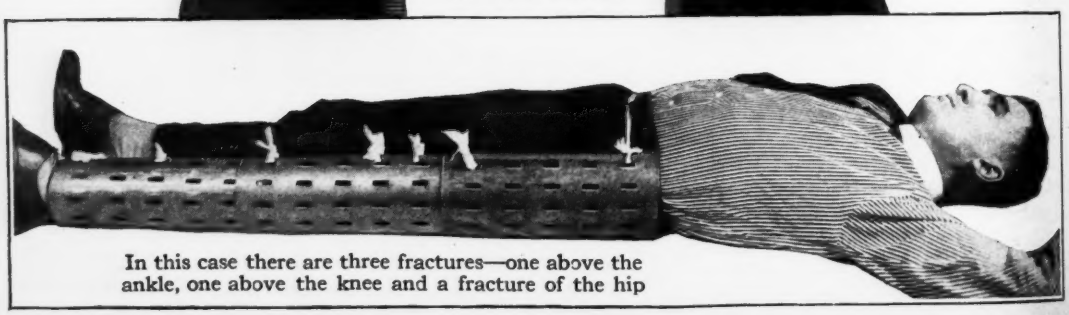


For a fracture of the skull one section of the splint is used and held in place by head and shoulder braces

The sections conform to the shape of any part of the body. Here one section is applied for a rib fracture

Two sections of the splint used separately for fractures above the wrist and above the elbow

Here the fracture is between the elbow and wrist. Padding of cotton or soft cloth is always used

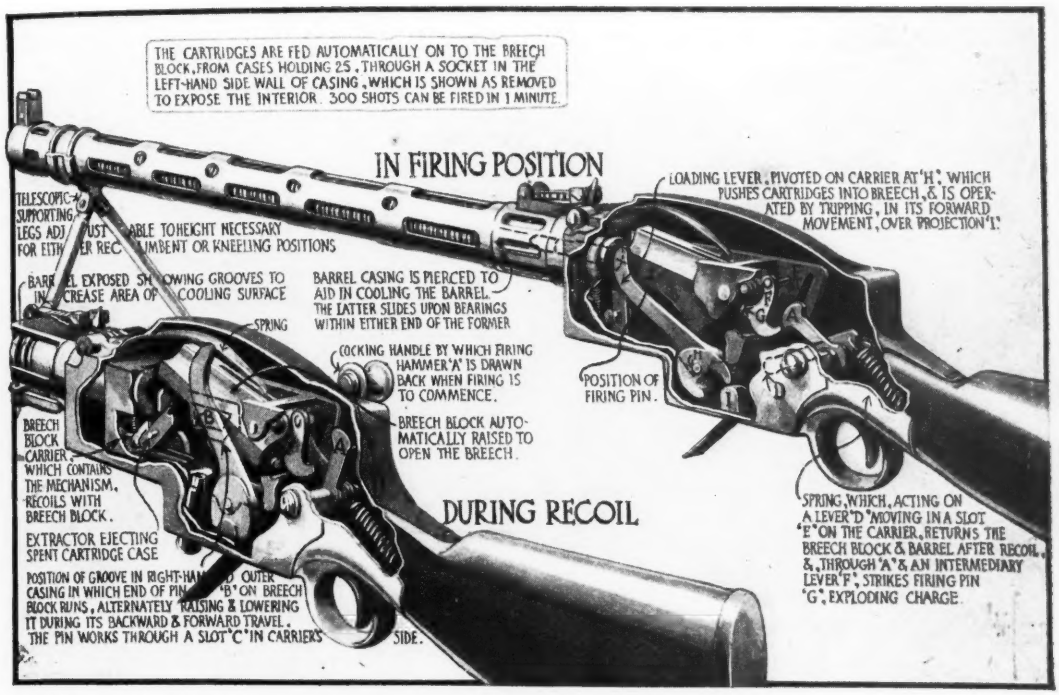


In this case there are three fractures—one above the ankle, one above the knee and a fracture of the hip

The Favorite Weapon of Assault

The difference between the automatic rifle and the machine gun is merely a matter of size

By Edward C. Crossman


THE CARTRIDGES ARE FED AUTOMATICALLY ON TO THE BREECH BLOCK, FROM CASES HOLDING 25, THROUGH A SOCKET IN THE LEFT-HAND SIDE WALL OF CASING, WHICH IS SHOWN AS REMOVED TO EXPOSE THE INTERIOR. 300 SHOTS CAN BE FIRED IN 1 MINUTE.
IN FIRING POSITION
LOADING LEVER, PIVOTED ON CARRIER AT 'H', WHICH PUSHES CARTRIDGES INTO BREECH, & IS OPERATED BY TRIPPING, IN ITS FORWARD MOVEMENT, OVER PROJECTION 'I'
TELESCOPIC SUPPORTING LEGS ADJUSTABLE TO HEIGHT NECESSARY FOR EITHER RECUMBENT OR KNEELING POSITIONS
BARREL EXPOSED SHOWING GROOVES TO INCREASE AREA OF COOLING SURFACE
BARREL CASING IS PIERCED TO AID IN COOLING THE BARREL. THE LATTER SLIDES UPON BEARINGS WITHIN EITHER END OF THE FORMER
SPRING
COCKING HANDLE BY WHICH FIRING HAMMER 'A' IS DRAWN BACK WHEN FIRING IS TO COMMENCE.
POSITION OF FIRING PIN.
BREECH BLOCK AUTOMATICALLY RAISED TO OPEN THE BREECH.
BREECH BLOCK CARRIER, WHICH CONTAINS THE MECHANISM, RECOILS WITH BREECH BLOCK.
DURING RECOIL
EXTRACTOR EJECTING SPENT CARTRIDGE CASE
SPRING, WHICH, ACTING ON A LEVER 'D' MOVING IN A SLOT 'E' ON THE CARRIER, RETURNS THE BREECH BLOCK & BARREL AFTER RECOIL, & THROUGH 'A' & AN INTERMEDIARY LEVER 'F', STRIKES FIRING PIN 'G', EXPLODING CHARGE.
POSITION OF GROOVE IN RIGHT-HAND OUTER CASING IN WHICH END OF PIN 'B' ON BREECH BLOCK RUNS, ALTERNATELY RAISING & LOWERING IT DURING ITS BACKWARD & FORWARD TRAVEL. THE PIN WORKS THROUGH A SLOT 'C' IN CARRIER'S SIDE.

One of the many types of automatic rifles recently evolved to meet modern conditions. It weighs about twenty pounds and is operated much like an American self-loading sporting rifle

THERE is no dividing line between a machine gun and an automatic rifle. Both types load, fire, eject the empty shell and load again by virtue of the recoil or the gases of the gun operating clever mechanism in the breech portion. They fire just as fast as the mechanism will operate as long as the trigger is held back, and the supply of ammunition is kept up, the speed varying from three hundred to six hundred shots per minute.

The American Benet-Mercié and the British-American Lewis gun represent the common idea of the automatic rifle, both being light and rifle-like in outline. The weightier Maxim is the typical machine gun, water-cooled and rather ponderous.

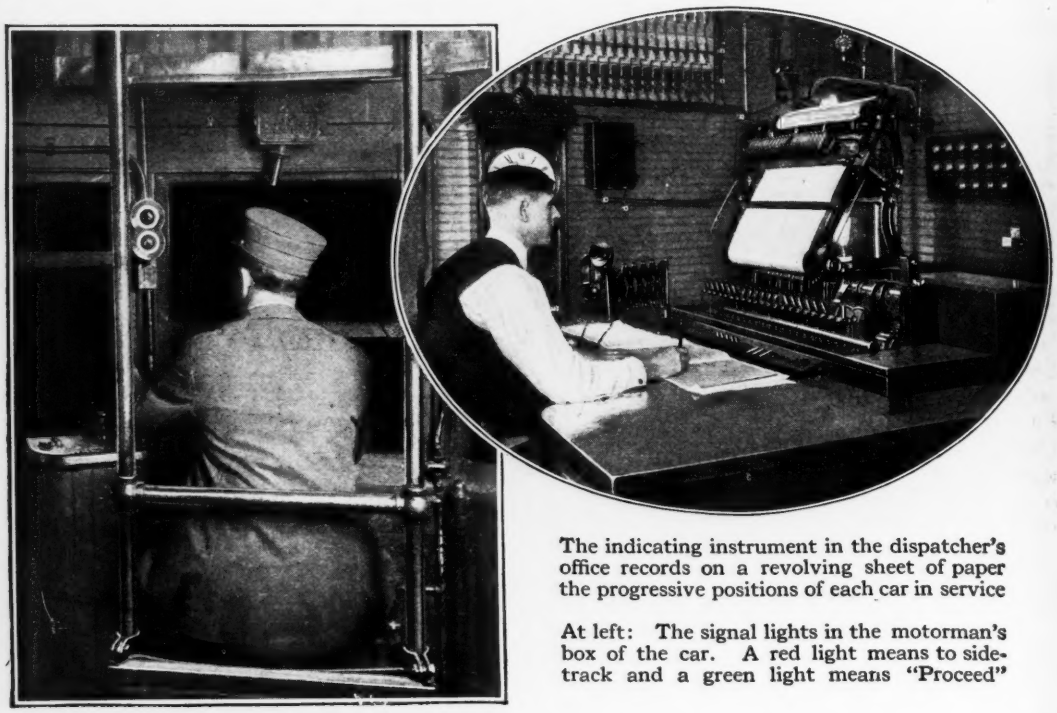
The gun illustrated is even more rifle-like than either the Benet-Mercié or the Lewis.

This gun is merely another modification of the light machine gun idea, and is not unlike our own Benet-Mercié. But where the mechanism of the Benet-Mercié is operated by gas borrowed from a tiny hole bored in the barrel and admitted into a regular gas-engine sort of cylinder with piston operating the gun, the weapon shown is operated much like a well known make of American sporting self-loading rifle. A backward movement of the sliding barrel unlocks the breech-bolt and permits the recoil of the powder gases in the chamber to open the breech block, eject the empty shell, cock the striker, bring a fresh cartridge into position, and compress the spring that serves to close the mechanism. Then the gun instantly fires itself again.

In both this gun and the Benet-Mercié the cartridges are fed in by means of a flat clip holding twenty-five or thirty cartridges. The Lewis uses a drum with several layers of cartridges, the Maxim and Colt use a webbing belt holding two hundred and fifty rounds.

Dispatching Cars on One-Track Lines

A new signaling system by which one man controls any number of cars

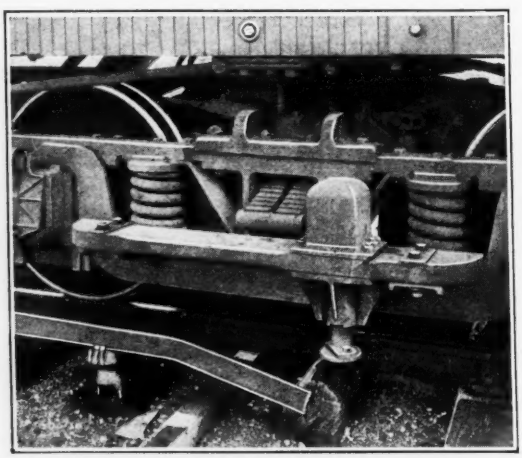


The indicating instrument in the dispatcher's office records on a revolving sheet of paper the progressive positions of each car in service

At left: The signal lights in the motorman's box of the car. A red light means to side-track and a green light means "Proceed"

A NEW signaling system for controlling interurban cars on one-track trolley lines consists of an indicating instrument at the dispatcher's office which constantly records the progressive positions of every car in service. This record is made electrically by a number of third rails which are strung along the tracks and at the sidings.

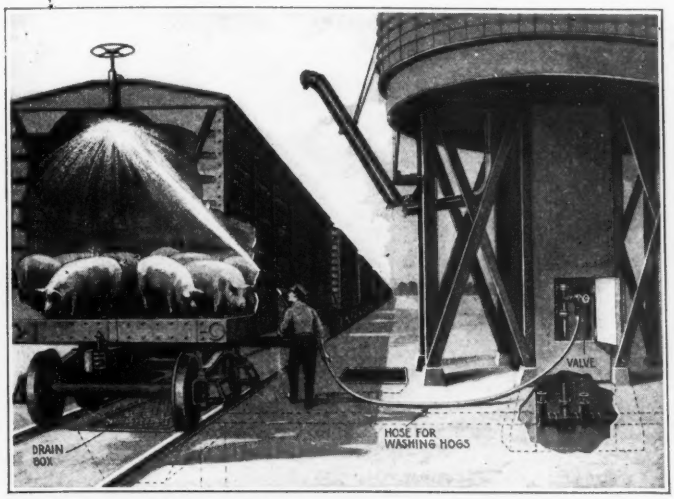
When the cars pass over one of the third rails, a shoe makes contact with the rail, and two electric circuits are controlled. One circuit is in the car itself and another leads from the rail to the dispatcher's instrument. The closing of the latter circuit operates an electric pen and records the arrival of the car on the paper of the instrument. The dispatcher immediately moves a lever which controls a return circuit to the third rail. It is this which operates the signal-circuit in the car. If the lever is moved one way, a relay in the car circuit connects in a green light placed above the motorman's head, and the motorman proceeds on his way. If the lever is moved the opposite way, a red light is shown, which light warns the motorman to turn from his course into the next siding. Arriving at the third rail at this siding, the motorman waits for the "all clear" signal before going ahead once more.



When the cars pass over the third rails two electrical circuits are closed by a shoe, one to the car and one to the dispatch office

Shower Baths for Hogs—A New Life Saver Used by Railroads

SHIPPING hogs to the slaughter house in freight cars is a precarious business. Strange to say, hogs, as a rule, do not suffer while the cars are in motion, but a great many die from overheating while the cars are not moving. Furthermore, the first warm weather of the season is more severe on hogs than the hot weather later in the season. A train may become stalled upon arrival at a division point and within twenty-four hours enough hogs may die from overheating to cause the shipper or the railroad a great financial loss.



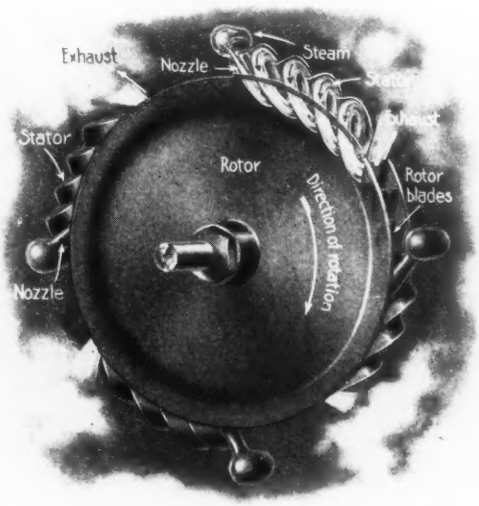
At the principal division points the hogs are given a shower bath to prevent them from becoming over-heated

To afford the shipper the protection he needs and to protect itself against loss, the Saint Louis and San Francisco Railroad has installed a hog-watering device at its principal division points. Immediately upon arriving at these points the freight trains carrying hogs are stopped and the hogs are given an impromptu shower bath, as the accompanying illustration shows. As a general thing a stream of water is first turned into the bedding underneath the hogs. After the bedding is well saturated the nozzle of the hose is turned to the roof of the car and the water falls on the hogs. A drain box is provided under the car to carry off the waste water.

The Simplified Turbine for Small Electric Plants

WHEREVER electric power is developed, some type of driving unit must be used to turn the generators. In the newest power plants, the steam turbine is being used. A steam turbine may be considered as nothing more than a windmill adapted to special conditions. Instead of wind striking against its curved blades, steam rushes upon them. The steam is directed by a nozzle, producing a compact stream of a tremendously high velocity which glances against one blade cast into the side of one of a number of driving wheels, and shoots into another blade on another driving wheel rotating beside it.

Such was the old-type turbine. The complexity of mounting a series of driving wheels on one shaft made it an exceedingly expensive engine, practicable only for a large size plant. A new method of guiding the steam so that the series of blades on the same driving wheel can be utilized, adapts it for the small power plant. The blades are sunk into the periphery of the driving wheel, and after the steam pushes against one, it is guided by a fixed stator in a helical path into another. After expending its energy on six blades, the power is converted into motion.



The steam simply flows in a helical path at high speed. During half of its journey it forces itself against the turbine rotor, pushing it around

Locating a Sunken Ship

A bell-buoy marker is an old idea with a new application especially appropriate for the times

A buoy provided with a bell which is rung by wave action continuously announces to passing vessels that a ship is submerged at that spot, until the salvaging ship arrives

A NOVEL form of marker for sunken vessels has recently been brought out, and is shown in the illustration. The idea is not new, but the modification here shown is interesting.

A loose buoy on the deck is attached to one end of a coil of rope, the other end of the coil being fastened to the ship. The position of a sunken ship that is thus equipped will be indicated by the buoy, which will rise to the surface if the rope is of sufficient length.

It is entirely possible to have the first coil attached to another, much heavier, and that in turn fastened to a cable of sufficient strength to aid in raising the vessel or assist in towing to shallow water. In this way the task of salvaging the ship would be somewhat simplified.

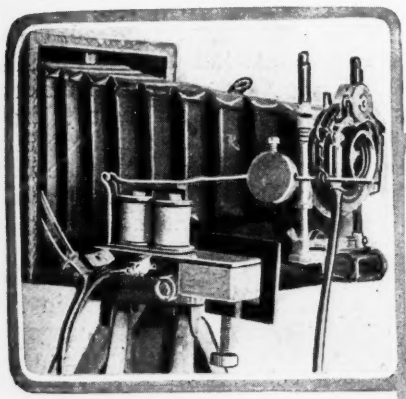
The buoy may be provided with a bell, rung by wave action by means of suitable clappers spaced about the circumference; so that the ship will toll out its own funeral dirge, into the ears of passers-by.

FOR PRACTICAL WORKERS

Electrically Operated Camera-Shutter for Photographing Birds

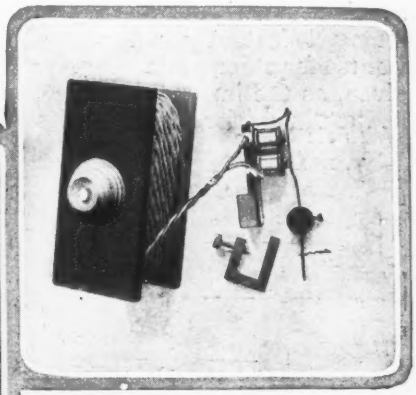
IN the attempt to photograph small wild animal life, particularly birds, it is necessary to have some means of operating the camera from a distance. Many methods have been tried with varying success, but the method described herein is conceded to be the best. The idea is simply to focus the camera on a spot where from previous observation the birds are known to come, and to have some means of operating the shutter from a distance. In the springtime the best places to focus are on or near the nests, and in other seasons on some suitable food supplied for the purpose.

There are three methods now in general use for operating the shutter. In one a string is attached to the shutter lever and simply pulled at the opportune moment. While fairly good, this is difficult to work at long distances and has the disadvantage of being liable to be operated by outside forces, such as wind-blown twigs. A long tube attached to the pneumatic release lacks the above disadvantage but is not instantaneous in its action. Besides, the rubber will, in a short time, become hard and useless from lying on the damp ground and may be easily damaged in



The magnets are attached to the camera bed with clamps where they operate the shutter release

A brown creeper partaking of a free lunch put on a fence post

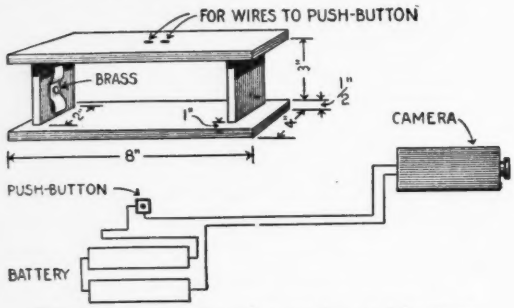


The spool for carrying the flexible cord incloses the battery for operating the magnetic shutter release

A chickadee near its nest with a bill full of grubs and a tufted titmouse on a post, attracted by suet

handling. The electric type of operator, although a little more bulky, gives real satisfaction and is very simple.

The illustrations plainly show the operation of the device. The agitator proper consists of two magnets similar to those used in a call-bell. These when energized attract the armature above them attached to a long rod, which is attached to the shutter lever by a small wire hook movable on it so as to follow the camera front when focusing. The small weight on the rod is to steady the movement and to allow the magnets to operate on less current, being thus assisted by gravity. The windings from the coils are led to two small brass screws in the side of the base, and it is to these that the spring clips on the cable ends are fastened. The small clamp holds the apparatus to the camera bed without altering its action in any way and may be removed instantly when the camera is wanted for other work. No dimensions are given, as the instrument must be built to fit the camera for which it is intended.



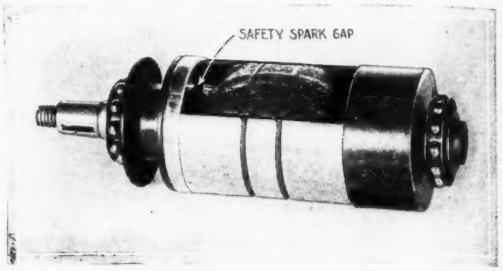
Dimensions for the wire carrier and battery, and the wiring diagram for the connections

The flexible lamp-cord used as cable is wound on a wooden reel which also holds the batteries. The core of the reel consists of two wooden end pieces connecting the flanges. The two double-cell flashlight batteries are slipped between the upper and lower pieces of the frame where they make contact with the spring brass clip fastened on the inside of the end piece. The wiring diagram shows the connection with the push button and camera.

The entire outfit, including plate-holders and other paraphernalia needed, may be fitted into a small rattan suit-case. The tripod legs when folded may be strapped to the outside of it. The only other requisite is an unlimited supply of patience, but as something of interest is always in progress in the woods and fields the time thus spent is by no means void.—C. BREDER, JR.

Troubles with the Safety Spark-Gap on Motorcycles

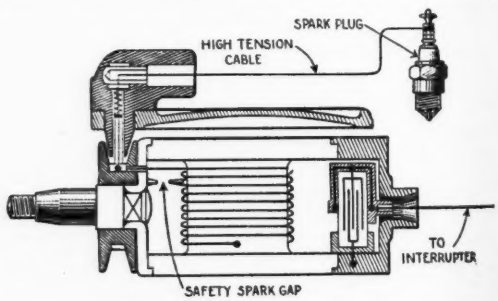
THE owner of a single cylinder motorcycle equipped with a well known make of high tension magneto, experienced some trouble with it which he attributed



Most high tension magnetos are provided with a safety spark-gap to prevent damage

to weak magnets. He accordingly took off the magnets and had them recharged. Upon replacing them he found the performance of the magneto to be worse than before. He then dismantled the magneto to look for further trouble in the armature and found what he thought at the time was the cause of all the trouble. As is well known most high tension magnetos are provided with a safety spark-gap, the purpose of which is to provide a path to ground for the high tension current generated in the armature, and thereby prevent damage to the insulation, in case the spark plug wire becomes disconnected or the gap in the spark plug is too great. These safety spark-gaps are arranged in various forms and in this particular type is arranged as shown in the accompanying illustrations.

The safety spark-gap back of the collector ring is clearly shown in the illustration. In the diagram the armature winding



A diagram of the armature winding to show how the safety spark-gap should be connected

in which the safety spark-gap is located is also indicated.

Anyone not experienced in the construc-

tion of magnetos would be likely to jump to the conclusion that the two ends of wire separated by a short gap were originally one continuous piece and the break was the cause of its not working properly. This was the conclusion reached by the investigator in this case and he proceeded to close the break with wire and solder. Upon starting up again it still refused to work. Having reached the limit of his knowledge of magneto operation he took the motorcycle to a repair shop where the trouble was soon found to be due to the magnets being wrongly replaced, that is, two ends of unlike polarity were placed side by side instead of like polarities. This would indicate the advisability of carefully marking magnetos before removing them so that they may be properly replaced.

In discussing the above incident with others the writer found that this safety spark-gap is frequently mistaken by amateurs for an accidental break and treated accordingly.—PAUL JUSTUS.

Filling Wide Vertical Cracks and Seams with Putty

IN puttying up a wide crack between two boards, excelsior may be used to bind the heavy mass of putty together and prevent its falling out. The putty is worked into the excelsior until the two combine in a plastic mass. After forcing the composition in tight, apply a smooth coat of putty over the surface. This method will be found convenient where holes or cracks would otherwise have to be filled with an inlay of wood.—JAMES M. KANE.

An Inexpensive Stove for Fruit Canning Purposes

ONE woman has solved the problem of an outdoor stove for canning and preserving in summer, by utilizing an old galvanized tub. A hole was cut in the bottom, a door in the side and a stove-pipe hole in the opposite side. A joint and an elbow of pipe made the stove complete.

It burns wood, and is placed in a shady spot on the hill back of the house. There the summer canning for private and commercial use is done in a larger measure of comfort than could be had in the kitchen.

The canning outfit is as simple as the outdoor stove. It is a common wash boiler and lid with a piece of mesh wire cut to fit the inside, and to lie flat on the bottom of the boiler.—PAUL GREER.

A Handy Farmer's Anvil Made Out of a Railroad Rail

IF there is a piece of discarded railroad rail at hand a very convenient anvil can be constructed as shown in the illustration. The length of the rail used in making this anvil is 36 in., and is placed in an inverted position on a stand made of 2 by 4-in. oak timbers 30 in. long. The upper ends of these pieces are pointed and fitted in the sides of the rail and clamped together with bolts. The bottom part is well braced. A board is laid on cross rails for a shelf. The end of the rail is pointed and cut to a shape similar to the end on the ordinary anvil. A hole is also made through each side projection for punching and to hold a hardy.—ROY PUGH.

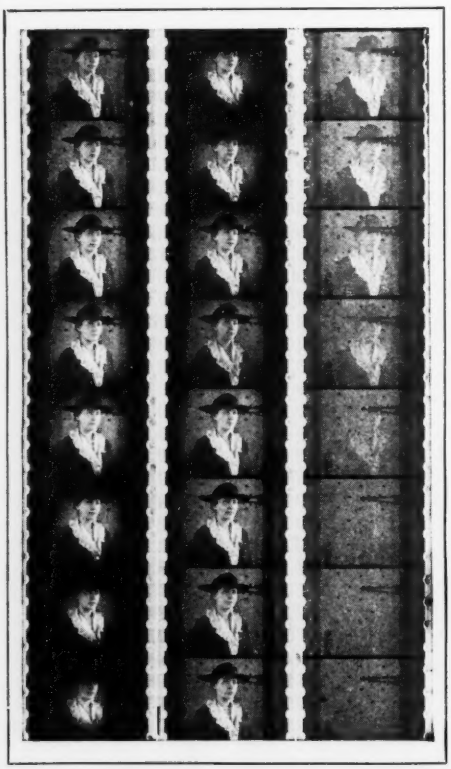
An inverted railroad rail rigidly supported on a substantial stand makes a convenient anvil

Lawn Sprinkler Made Out of a Length of Pipe

THE method of watering lawns here described will appeal to those who have held a nozzle in their hands for an hour or more at a time. Get a 20-ft. section of ¾-in. water pipe and drill 1/16-in. holes in it about every 2 ft. A coupling which will join the hose to the pipe can be procured for about twenty cents at most hardware stores. The piece of pipe can be easily moved from place to place over the lawn.—W. A. PARKS.

Making Movie Films for Artistic Projection

IT is a generally accepted theory that art is far removed from anything mechanical. We are told by artists that where mechanics and matter-of-factness exist,

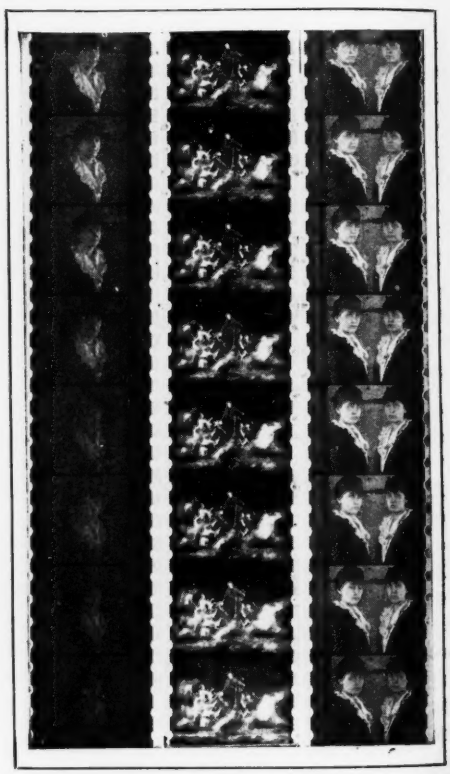


A special shutter opens and closes gradually to make a fade-in and a fade-out picture

there can be no true art. But how about the modern film plays? Even the casual attendant of motion picture theaters can not have failed to notice the highly artistic merits of modern film plays, especially during the past year. One by one, striking photographic tricks have been introduced, until today even the most commonplace scenic film is replete with pleasing effects. Strange to say, these artistic arrangements are produced by simple mechanical devices which in the majority of instances do not form an integral part of the motion picture camera. They are accessories. They are the products of the mechanic's brains and the palette of the film artist—a heresy indeed, for here we have recourse to mechanics in securing art.

Perhaps the oldest photographic effect in the films is the "fade-out," as well as its companion, the "fade-in." In the first, the entire picture, while retaining its original size and shape, gradually darkens until it disappears in a mass of black. In the reverse operation, the "fade-in" gradually develops a picture out of blackness. The fade-out effect is secured simply by slowly reducing the opening of the camera lens by means of its iris diaphragm, so that successive exposures receive less light. Hence the positive print becomes darker and darker. The second effect is merely a reversal of this operation.

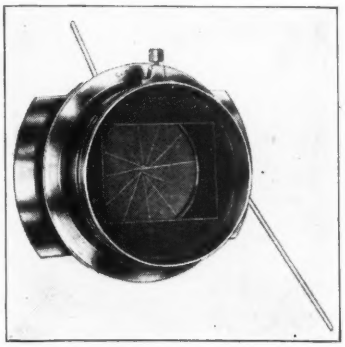
However, it often happens that the iris diaphragm of a lens does not close completely, in which case unusually light subjects refuse to fade out thoroughly. For this reason other means are sometimes employed. One of these is a special form of shutter, the opening of which closes gradually as the scene is being photographed, the action being entirely automatic and adjustable for a complete "fade-out" or "fade-in" in a given number of feet of film.



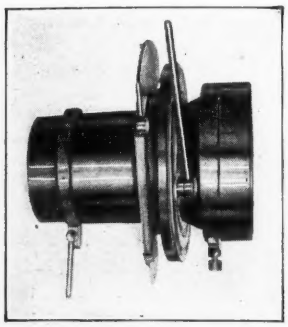
Double exposure work produced by the fade-out and fade-in with the curtain method

A screen of graduated transparency slides in front of the lens, running from transparency to opaque.

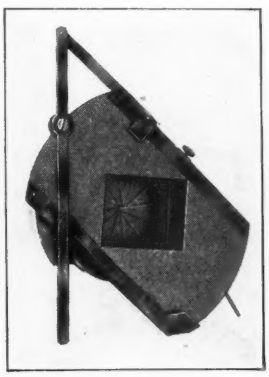
For dissolving views, as in cases where one scene appears to blend into another in a gradual and pleasing manner, the "fade-out" and the "fade-in" effects are employed. The first scene is faded out by the camera man, who carefully counts his turns or notes the position of his film-indicator hand. He then winds back the film the same number of turns, or until the hand on the indicator has returned to the position where the "fade-out" began, keeping the lens covered all the while. Then, with the diaphragm entirely closed, he begins taking pictures in the usual way for a "fade-in" effect, which is timed the same as the previous operation for the fade-out.



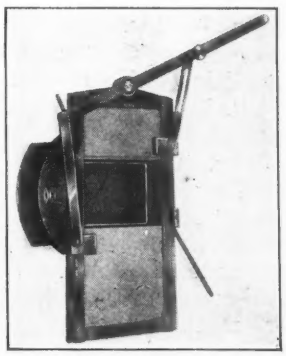
A circle vignetter in an extension tube on lens barrel



Side view of the circle vignetter showing iris which operates lever



A square closing dissolver that moves all four sides gradually



A curtain dissolver for use in matching what is called a "split stage"

A new-comer in the film field is the effect known by several different names, such as "circle vignette," "circle-in," and "round dissolve," which has met with great favor among film producers. In the films it causes a scene to shrink gradually, changing from a square or oblong image to a round image, which becomes smaller and smaller until it disappears in the center of a black mass. The effect is also used in isolating a character or an object, so that it will stand alone in a round, vignetted picture. At other times, it is used to soften the corners of an oblong picture.

The "circle vignette," or whatever one may choose to call it, is produced by an extension tube placed in front of the usual camera lens, and equipped with an iris diaphragm which is manipulated by a long lever. Since the sharpness or softness of the vignette edge depends entirely on the distance between the diaphragm and the lens, the tube is of telescopic construction to permit of sharp or soft outlines. When the diaphragm is placed as far away from the lens as the tube will permit, the circle vignette is sharp, but if the diaphragm is brought near to the lens, the outline is barely discernible, although of course the device accomplishes its mission just as effectively, and far more artistically. Whether the vignette edge should be soft or hard depends entirely on the subject which is to be photographed and the effect that is sought.

Another recently introduced effect is the "square closing dissolve," which attains the same ends as the circle vignette, but with the difference that the effect is a square one instead of circular. In a "square closing dissolve" the four sides of a picture move toward the center and the rectangular shape is preserved until the scene disappears entirely in a field of black. The device employed to secure this result consists of two shutter leaves with their facing edges cut out to form a right angle notch, which through the agency of parallel levers operated by a handle, overlap each other, more or less, as desired. Thus the size of the square opening formed by the overlapping

leaves can be altered, while maintaining a perfect rectangle. The square closing dissolver and the vignetting shutter are generally mounted in the same barrel so that either one may be used at will. In the case of the former device, it is placed as far away from the camera lens as is possible, so as to obtain sharp edges on the film images.

Still another device, the "curtain dissolver," is similar to the two devices just mentioned. Its effect is to cause the top and bottom of the film image, or the sides, to move toward each other. If desired, only one side of the picture is moved so as to stimulate the pulling down of a curtain or the drawing of a screen, or rolling door across the film image. It is employed to secure a narrow picture or to isolate a single narrow object, such as a doorway or perhaps a railroad switch. The device employed consists of two shutter blades which may be moved toward each other or moved singly, by means of levers.

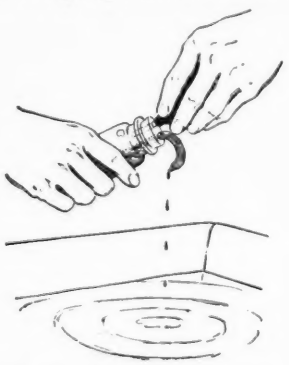
Sometimes the "curtain dissolve" is employed in double exposure work, in which case its blades are used to mask certain sections of the film during the different exposures. One blade is first moved up to a definite point so as to reserve a certain amount of space on each film square, while the first action is photographed. Here, too, the cameraman must keep track of the number of feet of film that are exposed, and, masking the lens, wind the film back to the starting point. The other blade of the dissolver is then moved over to meet the first blade which is then moved out of the way of the lens. Great care must be taken that the action of the second exposure coincides precisely with that of the first, for otherwise the effect fails to be convincing and may even be ludicrous. This effect makes it possible for an actor to play opposite himself. Entire film stories have been built around the cameraman's skill in this form of double exposure work. In good work the two sections of the picture are so carefully matched that they blend together with no dividing line showing.

Another method of double exposure work makes use of what is known as the "double exposure box." This device comprises a simple box placed in front of the camera and carrying a piece of ordinary glass, through which the camera photographs the scene. In taking the first action, any portion of the film may be masked out by pasting opaque pieces of paper of any size and shape on the glass window of the box. The film is then wound back to the starting point, with the lens masked in the meantime. The second action is then taken, after the glass window has been altered so that the portion formerly covered is uncovered, and the former transparent portion is covered. The result is that two dissimilar actions can take place in the same film scene.

This form of double exposure, it will be noted, confines the different actions to separate sections of the film. It is sometimes termed "split stage" double exposure. There is still another form of double exposure work where the two exposures are photographed on the entire film or are superimposed in part, such as the cloud effect, shown in one of the accompanying film strips. This effect is either obtained in the photographing, or in the double printing of the positive stock, with many interesting and weird results. Sometimes the titles of a film are printed in on the scenes, or the dialogue is printed in some convenient portion of a scene, which is accomplished in the printing process.

Dropper Bottle for Photographic Bromide Solution

A TEN per cent solution of potassium bromide is kept on hand in almost every photographic darkroom. The usual developing formula calls for a certain number of drops of the bromide solution. A handy dropper for this can be made by fitting a small large-mouthed bottle with a two-holed rubber cork and inserting a short piece of straight glass tubing in to one of the holes, while in the other a curved tube is inserted, its upper portion tapering like that of an eye-dropper. This tube extends to the bottom of the bottle. At the top of the short tube a rubber bulb is attached. When the cork is tightly fitted and the bulb squeezed slightly, the bromide solution in the bottle will flow from the tapered tube in drops..



Drops of bromide solution forced out by pressure

A Small Refrigerator Suitable for the Milk Bottle

MANY a baby has died of colic or summer complaint simply because the milk it received was not kept at a temperature low enough to prevent the development of bacteria in it. In an ordinary ice-box the thermometer usually registers from 55 to 60 degrees Fahrenheit; but to be safe milk should be kept below 40 degrees.

In its effort to better conditions for babies the Department of Health of New York city has planned a milk refrigerator which any mother may make for herself. If you want to try one of these model refrigerators, this is how to do it: Get a wooden box from your grocer—any box will do provided it is 15 in. deep. Buy a covered earthenware crock large enough to hold a quart bottle of milk. Next get a strip of linoleum or oilcloth 1 ft. wide and 3 ft. long. Sew the ends of the strip together and you will have a cylinder which will fit loosely around the crock. Put a layer of sawdust or excelsior in the bottom of the box; place the cylinder in the center of the box with the crock in it and then pack the excelsior or sawdust all around them. Nail a few old newspapers on the inside of the top of the box and your refrigerator is ready for use.

The crock in the box with ice packed around the milk bottle

A wood grocery box and an earthen crock, some linoleum, paper and excelsior make a milk refrigerator

As soon as you receive the milk in the morning (do not wait until it gets warm) crack five cents' worth of ice and place it around the milk bottle which you have put into the crock. Cover the crock and close the lid down on the box. This will keep the milk near the freezing point no matter how hot the day. Take the crock from the box every morning to pour off the water.—A. M. JUNGMAN.

Detecting Leaks in Inner Tubes by Means of Smoke

WHILE in India recently I entered a motorcycle contest, which was of the town-to-town type. It was from Calcutta to Gya, a distance of 300 miles, over roads which were covered with small, sharp-pointed stones, old shoes, nails and other things such as are to be found where there is bullock traffic of the eastern type, all of which are liable to make small punctures. Not being able to procure water to test my tubes and locate minute leaks, I took a pocketful of cigarettes along with me and found the following method a wonderful time and temper-saver as well as the only means of finding such punctures.

The defective tube is taken out and the valve removed. Then two or three mouthfuls of smoke are puffed into the tube, after which it is inflated as much as possible. The smoke will be seen to ooze out of any punctured place. The spot can then be sandpapered and dressed while the smoke is oozing out and locating the place for the repair patch. After the patch is applied the valve is again taken out to let the remainder of the smoke escape and the tube is ready for use again.—GEORGE THORNTON NORRIS.

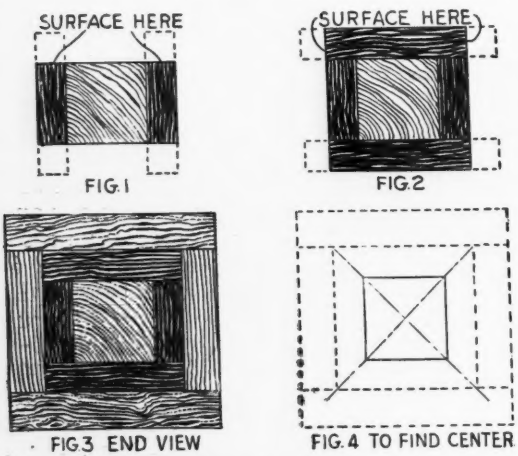
Cementing Tire Reliners to Make Them Hold

BEFORE cementing reliners, the paint on the inside of a tire should be scraped off. If possible turn the tire inside out, a part at a time, and buff with a power-driven brush. Neither gasoline nor other liquid preparations should be used. They gum up the surface and consequently make good work impossible.

Combining Different Woods to Make Fancy Indian Clubs

TO make the Indian clubs shown in the accompanying illustration, nine separate pieces and five different varieties of wood were glued together and turned to shape on the lathe. The resulting combination was very attractive and the work looked like a job of the very best inlay. No more than ordinary care was required to get a smooth appearing piece of work. Plenty of clamps were at hand, and the best glue obtainable was used in building up the pieces, the glue being given plenty of time for drying thoroughly before the next work was done.

The center stick was first squared up, making the surfaces exactly 1⅛ in. each way, and 18 in. long. To this stock two pieces of walnut 7/16 in. thick were glued, leaving the edges rough and projecting, as shown by the dotted line Fig. 1. After the stick had dried in a warm place for 12 hours, the clamps were removed and the edges planed down, even with the stock. Two more 7/16-in. walnut pieces were glued to the other two sides, as shown in Fig. 2, and the rough edges planed as before. The result was a stick 2 in. square. In the same manner another layer of different woods, ½ in. thick was built up. The last layer was used to make the heavy end of the club. Its length is only 12 in. measuring from the thick end.



Manner of arranging the different woods for making the outside contrasts to the surface

The piece was then ready to be put into the lathe. Great care was taken to find the exact center of the 1⅛-in. center piece, as illustrated in Fig. 4. Failure to get the piece properly centered in the lathe will result in unequal faces of wood in the clubs. By using a gouge, the block was quickly rounded. A mark was made about ½ in. from the heavy end, and exactly 17 in. measured off to the end of the handle. At 1½ in. from the handle end the piece was cut in to ⅞ in., the final size. The 1½-in. part was turned down to a ball 1¼ in. in diameter, to form the handle.

The appearance of the clubs when finished

The base of the club is 1⅝ in. thick, and at a point 5 in. from the base the diameter is 2¾ in. The stick was turned smoothly between these points, giving the shape as shown in the photograph. Most of the cutting was done with the gouge, and the piece was finished with the skew chisel.

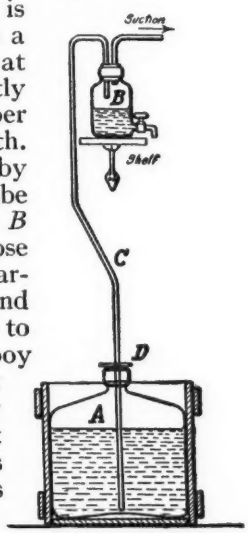
In order that the pair of clubs should match up well, it was necessary to use care in cutting the second one to the exact size of the first. To do this, the finished club was measured every inch, and the diameter of the second was made exactly the same as that of the first club at all corresponding points.

After cutting to size, all chisel marks were removed with a medium-grained sandpaper, and the piece was finished with No. 00 (very fine) sandpaper. While still in the lathe each club was given a coating of linseed oil, which was rubbed in with a rag. Following this, a coating of shellac was put on and dried, then rubbed smooth with No. 00 sandpaper. The club was then removed from the lathe and the rough ends were cut and smoothed. A coat of floor wax well rubbed on produced a high polish and proved to be an excellent finish.

Good contrasting effects were obtained by the use of the different woods. The clubs in the photograph have a center of sugar maple, a layer of black walnut, and top pieces of red cedar, burr oak, and red oak. Various results may be had by combinations of other contrasting woods. It is best for the beginner to practice on cheaper woods until he is thoroughly familiar with the lathe.—DEAN G. CARTER.

A Convenient Method of Handling Dangerous Acids

ACIDS are, at best, a nuisance to handle. The arrangement shown in the illustration, however, solves the problem. The original carboy of acid is shown at *A*, and *B* is a bottle with a stop-cock at the base and a tightly fitted two-hole rubber stopper in the mouth. The two are connected by a glass tube *C*. The tube passes from the bottle *B* down through a loose cover *D* placed on the carboy to keep out dust and dirt. It should reach to the bottom of the carboy and be slightly bent at the lower end to allow the acid to flow out freely. The short glass tube in the bottle *B*, is connected by rubber tubing to an aspirator or suction pump.



Acids removed from carboys with suction

Starting the suction pump reduces the pressure in the bottle *B*, and the acid is forced up into it by the external pressure of the air upon the surface of the acid in the carboy. Thus, the acid is caught and held in a closed vessel, from which it may be conveniently drawn off as desired, without waste or danger. No injurious fumes escape into the room and there is no possibility of burns being received from splashing, as the containers are not moved until they are empty. The acid is kept clean also.

Fine Aluminum Filings Make a Violent Explosive

THAT aluminum filings, made into a fine powder, form parts of two of the most destructive agents is little known. It has been used in the Austrian shells as a component of the high explosive agent. This explosive is known as ammonal, a mixture of five or eight parts ammonium nitrate and one part of finely powdered aluminum. Its explosive violence is tremendous. It is one of the few explosives that have never been used as propellants. No gun known to warfare could resist its suddenness. For this reason it is used only in projectiles.

Uncleanliness the Trouble-Maker for the Vulcanizer

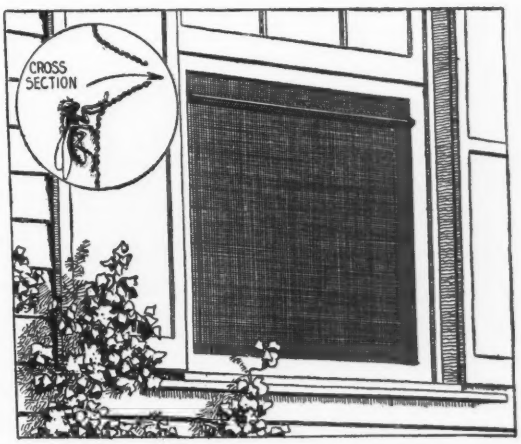
REPAIRMEN are often puzzled when a tire taken from one mold looks better than one cured at the same time in another mold. Both operations may have been performed in the same way, yet the results were different.

A dusty finger print, drop of moisture, a little oil from a tool, an insufficiently cemented spot at the edge of a patch, a tiny smooth space missed by the buffer—any one of these may have caused the difference.

Cleanliness and carefulness are always the first requisites for successful results, and the repairman who always inspects his work carefully after each operation, is the most likely to find the little trouble-makers before it is too late.

A Screen Door with a Special Exit for Flies

THE fact that a fly will walk over the entire surface of a screen sometimes trying to get out, led to the experiment which resulted in the exit attachment shown in the sketch. An ordinary screen was used in its construction and an outlet formed 6 in. from the top. The screen was placed in the window with the exit-opening pointing outward so that the fly in his travels would walk out. The screen is cut and a V-shaped extension applied. The small end has an opening large enough for the fly to pass out easily.

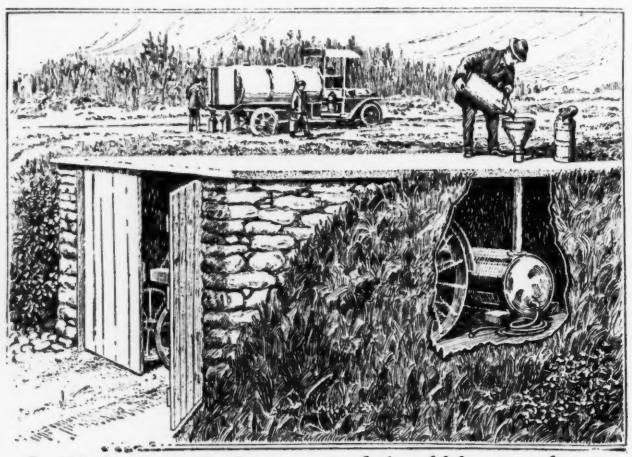


The projecting part shown at the top allows the flies to pass out but they cannot return

This device is valuable because it allows the flies within a room to escape and prevents their return.—C. H. THOMAS.

An Old Barn Converted into a Tractor Shed

THE accompanying illustration shows a very novel and efficient tractor shed which was made from a part of an old barn by removing the upper part of the barn and constructing a roof over the lower part in which the horses and cattle were formerly kept. Since the traction engine did not eat hay or food, the top part of the barn was not needed.



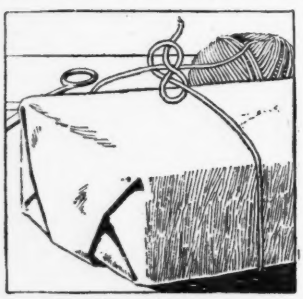
In this instance the lower part of the old barn made an excellent tractor shed also a cool place for storing gasoline

The present roof of the shed is just about on a level with the general surface of the ground and does not intrude itself upon the view. The traction engine is kept in the lower half of the shed which has been dug a little deeper in order to give more head room, and the other half is used for the storage of implements and tools. It also contains a tank in which can be stored 1,000 gal. of gasoline.

A large pipe runs from this gasoline tank up through the roof and the tank may be filled from the outside. This type of shed is very neat.—HAMILTON A. HOOPER.

The Right Knot for Making a Slip-Noose About a Bundle

WHEN tying a large bundle first loop the cord about it and fasten the tie; then carry the cord around as needed. The right knot for this first loop—one that draws tight and does not slip—is tied as shown in the illustration. The knot is then drawn together and the loop tightened around the bundle. Then proceed with the cording.—TUDOR JENKS.



Knot for a slip-noose around a bundle

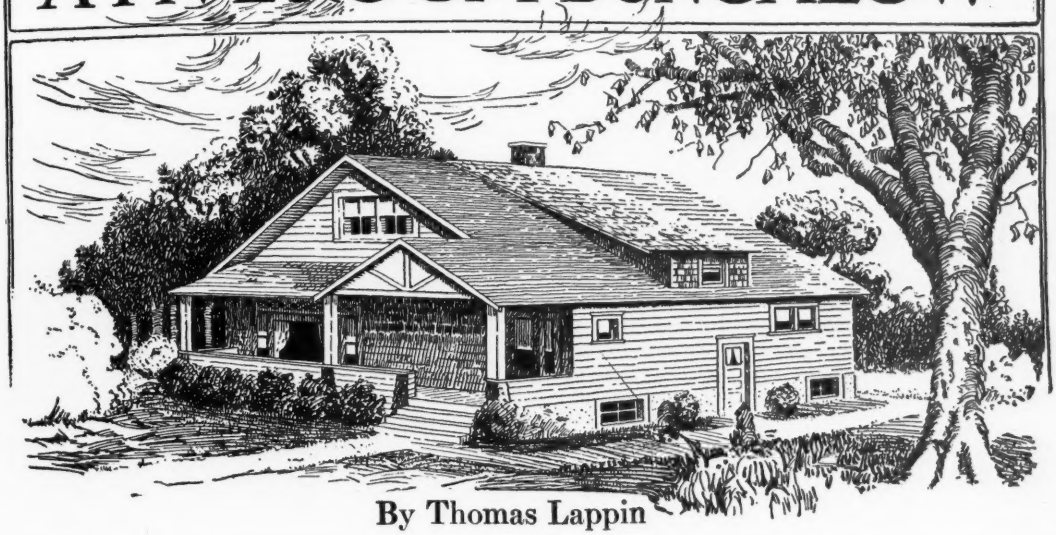
How to Patch an Aluminum Crank-Case

WHILE riding over a rough road I ran over a sharp stone which struck the bottom of the crank-case with such force that it punched a hole in the metal, thereby letting out all the oil from the engine. I took the machine to the nearest repair shop and was told that an aluminum crank-case could not be mended, and that it would be necessary for me to purchase a new one. I did not like the idea of ordering a new crank-case and waiting for two or three weeks to get it, so I decided to try the noble art of patching. I took the punctured part off, cleaned off all the oil and dirt, then with a mallet I drove the inside until it was almost out to place. I then poured hot lead in the cracks and crevices on the inside and did more pounding, always keeping plenty of lead in the crevices until I had the dent out perfectly smooth. There was no hole as the lead had filled all cracks and was pounded in. Then by carefully dressing the place I had a patch which was scarcely noticeable. The machine was used for years and the break never gave any trouble, and could be detected only by careful examination.—C. A. SPAESER.

Making a Paint that will Stand Washing

TO make a washable water paint, mix 25 lb. of the best whiting with 2½ gal. of water and let it stand overnight. The best way is to pour the water on the whiting and not mix it. The water percolating through the mass during the night makes a smooth paste. Work the mixture into one gal. of raw linseed oil. This is best done with the hands. The paste may then be thinned to paint consistency with oil, turpentine and driers. The paint will have sufficient gloss to be attractive and will wear well on inside work.

·A·FIVE-ROOM·BUNGALOW·



By Thomas Lappin

SIMPLICITY, convenience and compactness are the general features of this economical house. It has a large front porch facing east, door casing of light oak, body of house cream color trimmed with white, and shingles light green.

The entrance is in a small reception hall or vestibule with a long mirror behind the front door covering the stairway. There is a small hall or passage way from the vestibule to the kitchen, allowing a person to enter the kitchen without going through the living-room. This hall is seldom found in small houses. The basement door when opened closes the opening in the hall to the vestibule. There is also an outside basement door.

Between the vestibule and the large living-room are two pedestal bookcases 4 ft. high. The living-room may also be used as a dining-room, upon special occasions, and instead of removing the dishes after luncheon the table with its load is pushed into the kitchen through a special opening. This opening is covered with a wall panel in two sections, the lower sliding up like a window sash inside the upper half, leaving ample room for a large table to pass through. There is a small buffet near the fireplace with drawers below for the table linen.

The fireplace is set on the inside and the heat from the hot bricks in the back helps to keep the bathroom warm. However, a small hot water furnace heats the house. There is sufficient inside wall space for a piano and a corner for the bed davenport.

A wood lift is built in the wall near the range. It is filled in the basement with a day's supply of fuel and drawn up where it is handy for the range. Above the lift are cupboards. The kitchen has plenty of cupboards, bins and drawers. The iceless refrigerator in the corner has cold water coils for shelves, and fresh air draft passes up through them. The drain board to the left covers a wash tray. This room is light and airy, and to save steps the table is set near the rear window, except when it is used in the living-room for guests.

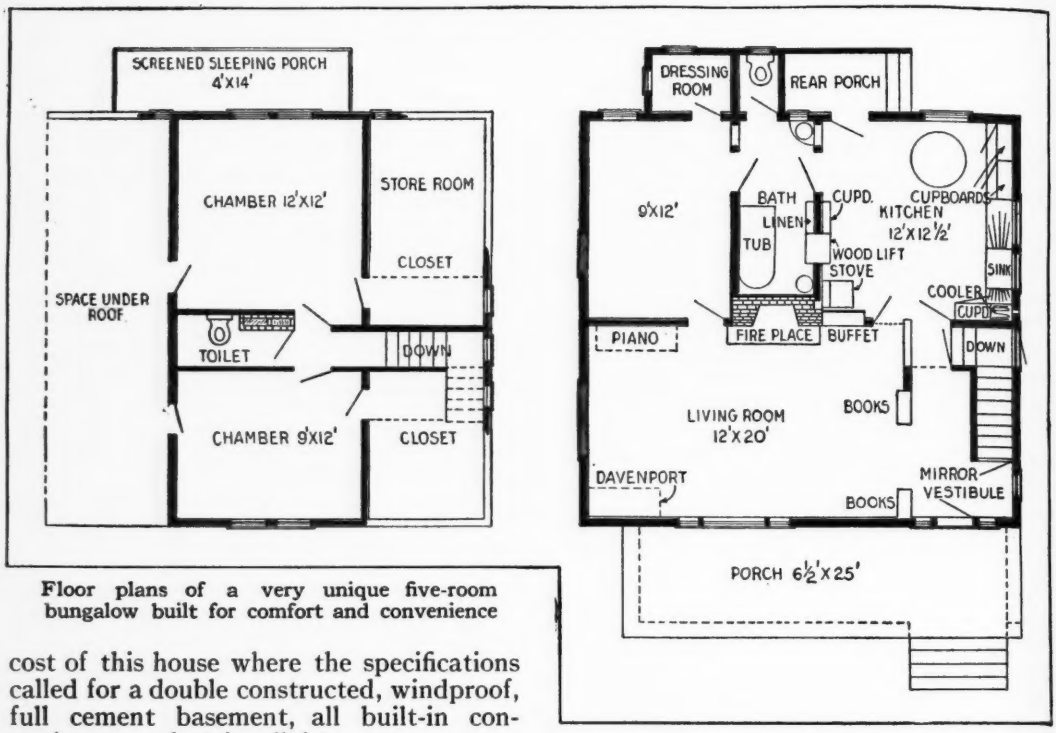
The bathroom is always warm, as it is heated from the hot water tank, which is placed in it, and the back of the fireplace. It contains cupboards, cabinets and a corner washbowl. The doors to the bathroom when opened effectually screen the bathtub and form a passageway to the bedroom. The toilet is in a separate room where it can be ventilated from the outside without cooling the bathroom.

The plumbing is not put in for the convenience of the plumber, but for the housewife only, and if properly protected it will not freeze. Another new feature is the dressing-room set off from the bedroom. A long mirror may be set in the corner between the two small windows. The bedroom can be reached from the living-room or the kitchen.

The entrance to the stairway to the second floor is cleverly concealed by the mirror

door. There are two bedrooms for the children, or for guests, as the case may be, with a hall between them. In this hall back of the chimney is an extra toilet for the upper floor. It is lighted by a skylight. From the rear room there is an entrance to a small sleeping-porch. There are plenty of closets and storage rooms. The furnace, though small, provides ample heat. It has a thermostat and a thermometer to regulate and register the heat.

Different contractors have figured the cost of this house where the specifications called for a double constructed, windproof, full cement basement, all built-in conveniences, electric lights, gas, water, furnace, and first-class workmanship, to be from $1,200 to $1,400.



Floor plans of a very unique five-room bungalow built for comfort and convenience

A Chicken Brooder That Does Not Require Heat

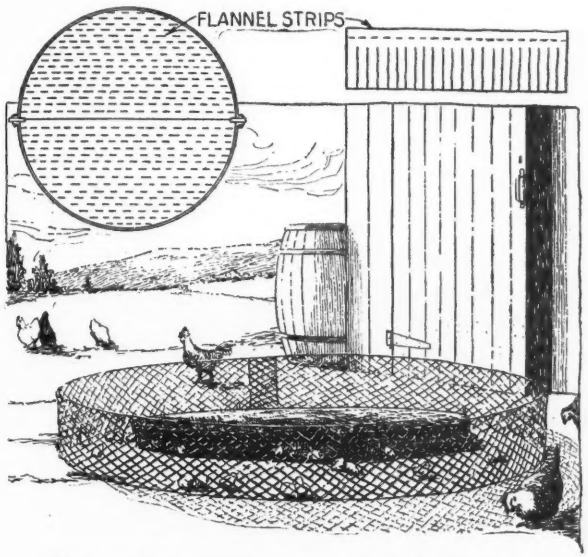
A POULTRY farmer of Utah, who every spring raises several thousand chickens to keep up a large flock of hens, has discarded a rather expensive brooder house with fine heating equipment and now uses a very simple cold brooder. The saving of labor in controlling the chicks, the elimination of the care of lamps, thermostats and regulators, and the fine efficiency of these hovers attracted much attention from poultry farmers in the vicinity.

Two halves of a ring of ⅝-in. iron were made by the local blacksmith. The halves were hinged together, and a burlap blanket was stretched across the entire ring and stitched to it. Over the entire lower surface of this burlap, strips of felt or canton flannel were stitched 2 in. apart, each strip being cut into 2-in. sections 3 in. long and hung from the burlap.

These hovers are 5 ft. in diameter—large enough to cover 225 or 250 chicks—the usual results from a 300-egg incubator. They are set in the laying pens which will house the pullets when raised. Two small stakes are driven into the ground, to receive the bolts which hold the halves of the ring together. The bolts also serve to hold the ring securely in position. Two other stakes catch the outer edges of the ring and support it at the right distance from the ground—about 4 in.

Each brooder is first inclosed with wire netting having 1-in. mesh, 20 ft. long and 1 ft. wide. This is done for simplicity of operation and ease in controlling the chicks and herding them for the first few days. When the chicks come from the incubators the wire fence is drawn around the hover, one-half of which is raised to permit the chicks to enter. Straw is placed around the outside edge of the hover in layers thick enough to hold in the warmth without cutting off the ventilation.

On the second day the straw is pulled back and the circle of wire fence is enlarged so as to leave a 1-ft. open space all around the hover, into which the chicks may run without getting far from the blanket. Several times this first day a minute's work contracts the wire fence, by sliding one end past the other, and so huddles the chicks under the hover again. This is for education as well as to guard against chilling off too much, for many of the chicks will, on that first day, thus learn that the hover, with its comforting blanket and strips on their backs is the place to find warmth, comfort and security. This hover is open all round and the chicks can dodge back under it at any instant. At night, or if the weather strikes in cold through the day, a minute's work closes in the fence and a few kicks put the straw protection around the outside. After the first two days the chicks take full care of themselves. Only at night are the closing up and the adjustment of the straw necessary. The only objection to a cold brooder is that the sudden change from the 103 or 105 deg. of the incubator to the cold floor, cold litter and cold blanket—if there is one—is likely to cause mischief and a serious check to development, although a large number of chicks raise the temperature very quickly. In this brooder this trouble is eliminated by the use of heated bricks. The night before the incubator is to be emptied a dozen bricks are heated in an oven, and are placed beneath the hover. Then heavy blankets or grain sacks are laid over them. In the morning the floors, the bedding and burlap are warmed so thoroughly that the chicks get no shock. After that no more artificial heat is needed.



Rings of iron covered with a burlap blanket to which strips of felt or flannel are stitched to hang down and cover about three hundred chicks

About a week after the chicks are put in, the wire fence is taken away and they have the run of the house.—GEO. F. STRATTON.

Distributing Cards in a Pack and Disclosing Them

SELECT the four kings from the pack, also two other court cards—preferably jacks—and spread them fanwise, being careful not to show the jacks. In adjusting these cards place the two jacks back of the first king. As these jacks are hidden behind the king they are invisible to the audience, who must be satisfied that the cards are all kings and nothing else. These cards are then placed on top of the pack. State that you are about to distribute the four kings in various parts of the pack. Take up the top card, which is really a king, and exhibit it, if need be. The next card, being a jack, should not be shown to the audience, but should be taken up carefully and placed anywhere in the pack. The next card is also a jack, and it is placed in another part of the pack. The next card can be taken up carelessly and replaced on top. Three kings will be at the top and one at the bottom of the pack. When the cards are cut the four kings will be in the center.

Making a Bit Point Take Hold in a Knot

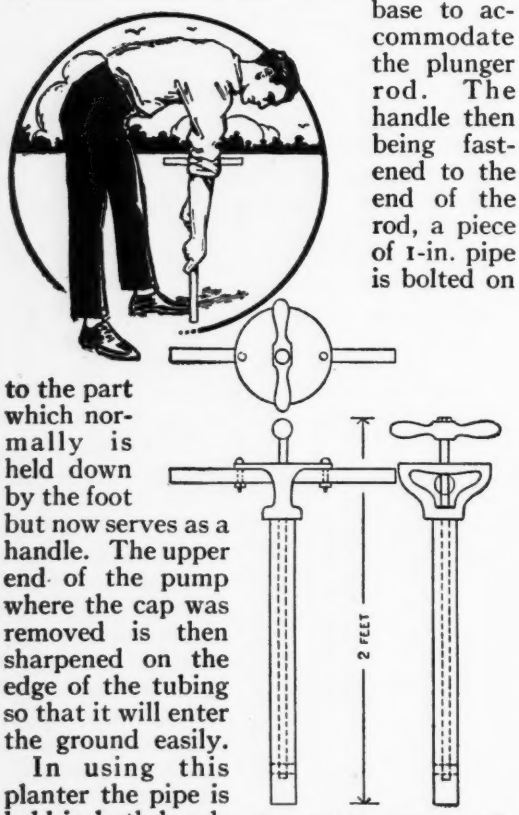
THE wireman frequently finds places, especially when boring overhead, where his bit stops feeding, and it becomes almost impossible to make it take hold again. In such cases, take your bit out of the brace, and substitute one a size or two smaller. This will usually start to feed without any great trouble. After boring three or four turns, put the right size bit back in the brace. When it commences to bore, a little care may be necessary to prevent it from feeding too fast. If it should later on lose its hold again, the same method may be repeated.

Finding Leaks Quickly in Air Tanks

WHILE visiting a rock quarry I saw the workmen using a new method for finding leaks quickly in compressed air tanks. A plug was removed in the upper part of the tank and a large spoonful of oil of peppermint poured in. The plug was screwed back in and the compressor started. The leak was soon found by the odor of the peppermint. This method may be used to advantage for finding leaks in small acetylene lighting plants.—EDWARD GYGER.

Making a Bulb Planter from a Foot Pump

THE foot pump should have an inside diameter of at least 1½ in. The plunger is taken out and a hole bored through the base to accommodate the plunger rod. The handle then being fastened to the end of the rod, a piece of 1-in. pipe is bolted on to the part which normally is held down by the foot but now serves as a handle. The upper end of the pump where the cap was removed is then sharpened on the edge of the tubing so that it will enter the ground easily.



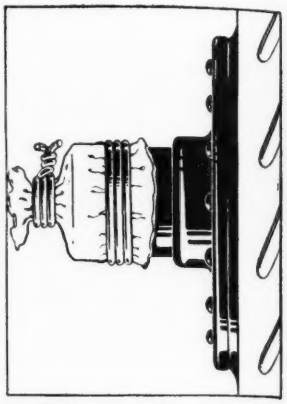
Inverted foot-pump used as a bulb planter

In using this planter the pipe is held in both hands and pushed into the ground to the desired depth, which for bulbs is about 5 or 6 in. The wood handle then rises and indicates the depth of the hole. On withdrawing the pipe from the hole a solid core of earth is left in the end of the pipe which may be easily expelled.

The advantage of this planter is that it leaves a hole with a flat bottom and also does not compress the earth as in the case of a pointed stick. The maker of this has put in several thousand tulip bulbs with it in dry hard ground very satisfactorily.

Substitute for an Automobile Hub-Cap

A PIECE of inner tubing approximately 6 in. in length will serve as a ready substitute for a lost hub-cap until a new one can be provided. Should such a cap be lost there is great danger of the dust and grit collecting on the inside of the hub and causing damage beyond repair to the ball-bearings within. The piece of tubing is held to the hub with the aid of wire wound tightly around it, while the other end is closed with wire to prevent the dust entering there.—ADOLPH KLINE.


Tube covering end of hub to keep out dust

A Drill of Self-Hardening Steel for Working Marble

DRILLING holes in marble is very wearing on tools. A piece of the best steel, tempered as hard as fire and water will make it, loses its edge and its size very quickly when used for this work. It is not that the marble is so hard, but the gritty nature of the material acts on the tools like an abrasive. A parallel case is that of machine-shop work on iron castings which have not been well cleaned of the molding sand. Machinists say that the sand wears out tools faster than the hardest iron.

Concerns that make a specialty of marble work, such as switchboard slabs, etc., use drills made of self-hardening steel and find nothing to equal it. A short piece of round or square steel is flattened out to a drill point and is generally used in a ratchet drill following a hole made with a small twist drill. Self-hardening steel can be forged and allowed to cool in air without affecting its temper.

Simple Designs for Sheet Metal Working

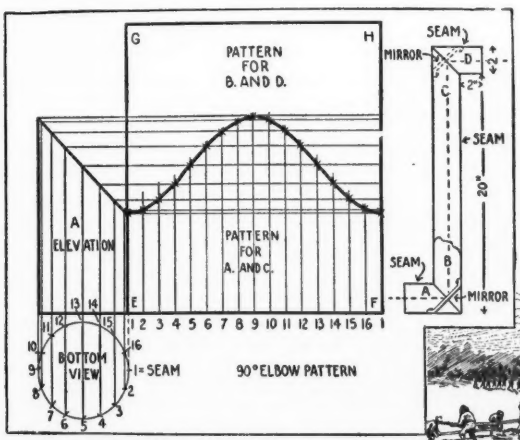
I.—Trench periscope or corner lookout for boy scouts developed from a ninety-degree elbow pattern

By Arthur F. Payne

Assistant Professor Manual Arts, Columbia University

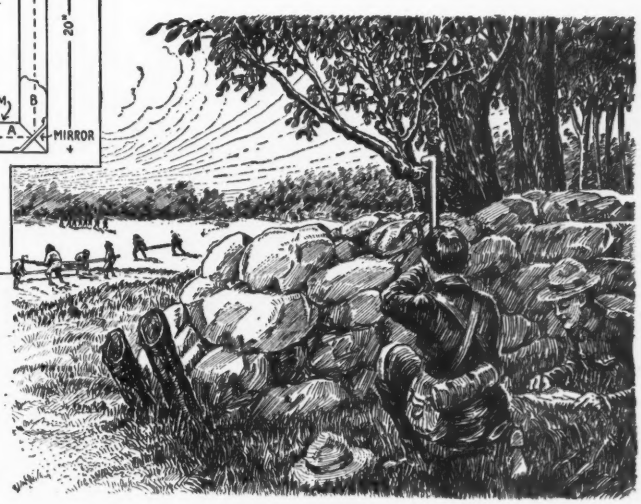
ONE of the most important "safety first" inventions of the present great war is the trench periscope. By the aid of this very simple invention the soldier is able to look over the top of the trench and observe the movements of the enemy in comparative safety. It is also used in looking around the corner of one of the modern zig-zag trenches when a part of a trench has been captured and the enemy is still in the other part.

The periscope is a necessity to the soldier, but there are many ways in which the out-of-door boy may use it. In "I Spy," "Hide and Seek," etc., the possession of a periscope gives one a decided advantage. It is of value in Boy Scout activities; looking over a wall, from the back of a building, or from behind a bush or rock, the scout can observe the territory beyond without exposing himself.



A pattern layout for the construction of an ordinary elbow in sheet metal. Diagram showing mirrors as shown in the diagram. The mirrors must lie squarely across the elbow, being held in place by strips of tin soldered to the pipe on the inside and then bent over the mirrors.

For the benefit of the boy who is working in a shop and wants to make periscopes for sale, or who wants to know the inside of that mysterious process called "developing patterns" the method of developing the pattern is given. The same pattern will do for all the pieces *A-B-C-D*. All that is necessary is to develop the pattern for piece *A*. Draw the elevation "A" the size and shape of the elbow desired. Draw the bottom view of the pipe as shown. Divide the bottom view into 16 equal parts and number them. Draw the base line *E-F*, getting its length by taking the distance between any two points on the bottom view, and stepping it off 16 times. Number these points from 1 to 16. This will give the circumference of the pipe. It may seem strange that at each end of the base line we have a line numbered 1, but when the pipe is bent around into a tube these two lines come together and form one point, as is seen in the bottom view where it is marked number 1-seam. From the

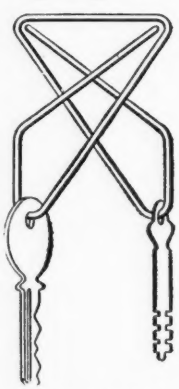


To make one, take 3 pieces of tin pipe 2 in. in diameter. The largest piece should be 20 in. long. Solder the two short pieces to the ends of the long piece at right angles to it, forming an ordinary 90 deg. elbow. Before the pieces are fastened together, fit two pieces of mirror in place in each elbow

points on the base line *E-F* draw the lines up at right angles to the base line. Draw a line through the points on the bottom view and continue these lines up to the joint line at the top of the elevation "A." From the points where these lines touch the joint line draw lines at right angles the full length of the base line *E-F*. Now take a lead pencil and starting on point 9 on the bottom view follow the line up the elevation, turning at the joint line, following it along until it crosses the line number 9, coming up from the base line. Make a cross at this point. Do the same for points 8 and 10, making a cross where the line crosses 8 and 10 lines coming up from the base line. Do the same for all the other points. Draw a curved line through all these crosses, and the pattern for section *A* is finished. Allow 3-16 in. extra stock for the seam at the edge. It will be noticed that the pattern for *A* is the same as for *C*. The curve is exactly the same for *B* and *D*, except that the seam is on the long part of the pipe. To get this pattern continue the number one lines from the base up to the points *G* and *H*. Connect these and you will have the pattern for parts *B* and *D* as indicated in the drawing. When the periscope is finished paint it a dull brown or other inconspicuous color.

Large Paper Clip Used in Place of a Key Ring

WHILE it may not be quite as convenient as the circular key-ring for general use in the pocket, the paper-clip illustrated works very well and provides a very satisfactory means of holding keys together where they are to be hung up or kept in drawers. A box of them may be purchased for a few cents and in several sizes up to about 2 in.

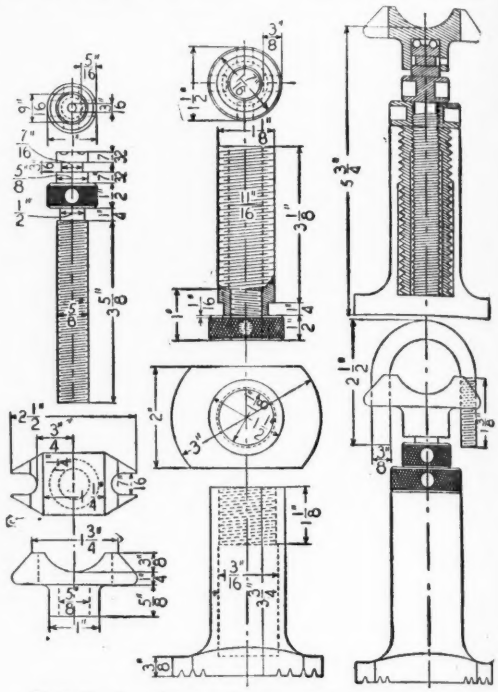


Substitute for a key-ring

The special kind of a clip shown makes an exceedingly good key-holder for the reason that keys of different sizes may be kept separate on each end of the wire; or the latch key may be kept to itself on a separate section of the clip where it may be easily found in the dark. A small clip may be used to fasten the latchkey to the usual ring.—JOHN D. ADAMS.

A Telescoping Motorcycle Jack for Road Use

SOON after the purchase of my new motorcyle my tire went flat on the front wheel. It happened on a smooth stretch of state road. In looking about for a stone large enough to place under the engine frame to raise the tire off the ground none was to be found. After a delay of about a half-hour I was under way again; but this taught me a lesson and I decided not to be caught in the same fix again.



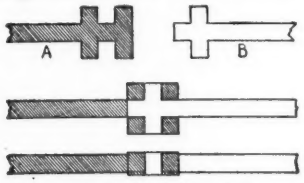
Detail drawings of an easily made jack designed especially for use with the motorcycle

I constructed a small telescoping jack, which I call the double lift. It fits very nicely in any of the tool boxes, measuring, when closed, 5¼ in. It has a maximum working height of 13 in. and weighs 2 lb. A small U-bolt is attached to the head of the jack for clamping it to the frame of the machine, directly under the engine. This clamping feature serves a double purpose; first, it keeps the machine from overturning the jack, and second, when the machine is on an incline the jack can be locked to the machine at any angle.

The base of the jack is made solid so that it is dust and moisture-proof. This base part also serves as an emergency anvil for repairing a broken chain and the like.—JOHN F. FETTERLY.

Rigid Joints for Making Models in Thin Sheet Metal

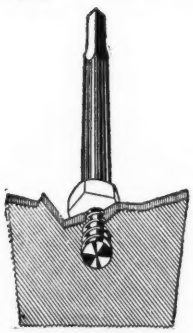
IN making some small models in tin I used the joint illustrated for connecting the parts, which is original as far as I know. The joint as indicated is a rigid one and lends itself well to tin, soft sheet iron, sheet brass or sheet copper. It can be used in many places in arts and crafts works. In the illustration the part marked *A* is superimposed on *B*, the two tabs on *A* are bent backward, while the four tabs lie almost flat, then they are squeezed together tightly with pliers or lightly hammered.—R. S. MELVIN.



A simple joint for any soft sheet metal

Making a Valve-Grinder of an Old File

WHERE there is no grinding outfit at hand a substitute can be readily made from a piece of old mill-file, as shown in the illustration. The file is annealed and a piece cut from it large enough to cover the valve-seat; then it is drilled centrally and tapped. Into this tapped hole is provided a threaded rod with a squared end, having a locknut to hold it firmly in place. The piece of file is then tempered and used as a cutter on the valve-seat by turning with a brace or breast drill.


The file cutters true up valve-seats quickly

Preventing a Tire from Sticking to the Vulcanizer Mold

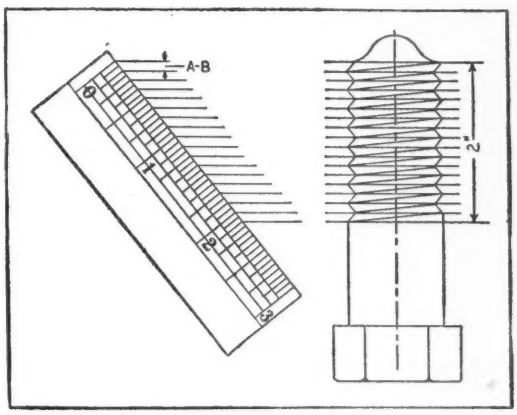
THE sticking of tires to the mold after vulcanization has always been a great source of annoyance to repairmen. The best applications heretofore used as possible preventatives have been unsatisfactory in some respects. Therefore the discovery by a repairman of the availability of a material which overcomes this trouble will be welcomed by vulcanizers. Since the discovery is so simple, the wonder is that no one has reported it before. The substance used is nothing more nor less than cocoa butter and is applied as follows:

Clean the mold thoroughly with fine emery paper. Then after allowing it to warm up a little, go over it with a piece of cheese-cloth saturated with the cocoa butter. Next wipe till glassy and apply soapstone. This method of preparing the mold has been tried and found to work perfectly.

Dividing Line into Odd Spaces with Ordinary Rule

ROUGH shop sketching for showing minor operations does not, of course, need to meet the accurate standards of the work sent down from the drafting rooms. However, at times such sketches must be to some sort of a scale, accomplished with any tools available for the purpose.

The sketch shows a very practical way of dividing a line of given length into a certain number of parts without a regular scale for the purpose. Suppose a 2-in. line on the center of a bolt is to be divided and spaced off into 17 equal parts. The two ends of the threaded portion are laid off to 2 in. and parallel lines are drawn to the left. A standard scale is laid between the two lines in such a manner as to cover exactly 17 equal divisions on it. In this case it would be 8ths or 2⅛ in. These are marked off to the right and carried over with the T-square or its substitute

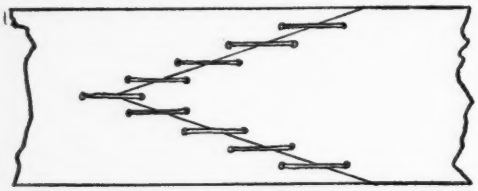


Spacing odd dividing lines for the threads of a bolt with the use of a rule

to the 2-in. center line of the bolt. The same results could be secured with a pair of small dividers, taking only the first space marked off by the rule or the line *A-B*, then spacing it with the points on the 2-in. center line. The above principle can be applied to many other shop propositions, where rather primitive methods must secure fairly accurate results.—F. W. BENTLEY.

A Belt Joint for Use in a Damp Place

THERE seemed to be no end to the trouble caused by a belt which had to be run in a wet place, for the reason that the joint could not be kept glued, and a laced end jarred the oil out of the bearings.

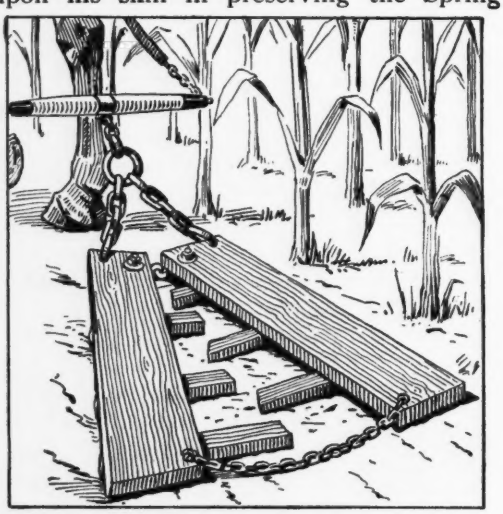


A V-shaped splice with the laces in a straight line with the grain of the belt

The method illustrated was adopted and was found to give good service in many other places of belt trouble. It involves a pointed joint. The exact center of the belt should be found for the pointed end; then it is cut and laid over the other end and marked for the V-notch. This will make a perfect joint. The holes for the belt-lace are marked with a square to make them so that the lace will run in a straight line with the belt. This will make a smooth repair for places where the belt must be taut and run at a high speed.

A Dust Mulch Cultivator to Keep Moisture in Soil

THE farmer's supply of moisture for maturing a crop of corn often depends upon his skill in preserving the Spring



This device is dragged over a crusted surface to make a dust blanket above the damp soil

season's rainfall. This may be done by keeping a dust mulch or "dust-blanket" over his cultivated field. With this aim in view, some farmers drag a mower wheel between the corn-rows. While this is successful in a large degree, it has been found that the wheel often injures the brace roots of the corn.

The implement that will make the best mulch with the least injury to the corn is the one described. Procure two boards 5 ft. long, 10 in. wide, and 2 in. thick for the frame. Beneath this frame run cross sections of 2 by 4-in. material about 12 in. apart diagonally with frame of drag. Let the back ones be longer than the front ones and extend toward the inside of the frame. The frame is fastened together at the front end with an eye-bolt bent in a U-form so it can be fastened through the frame. This allows the drag to take an A-form if the chain hitch is fastened on the outside corners. Across the rear end is an adjustable chain for regulating the width of the spread. This is used to allow the drag to spread and close, so as to accommodate itself to the width of the corn rows. It works all the ground between them, and does not injure the brace roots. The instrument is especially needed after the corn has become too large to cultivate with a cultivator.—RALPH A. PAGE.

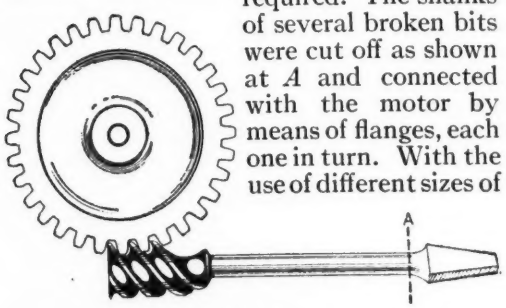
Collecting Gas from Mud in a Stream of Water

WITH such simple apparatus as a bottle, a funnel and a stick, one can obtain gas from the mud at the bottom of a pond or stream. If wading, select a place where the water is waist deep or slightly deeper; if in a boat find shallower water. Punching the mud with the stick causes bubbles of gas to rise. Insert the neck of the funnel into the neck of the bottle, submerge both, and after the bottle has filled with water, hold the mouth of the funnel over the rising bubbles, making them enter the bottle and displace the water. When a sufficient quantity of gas has accumulated, remove the funnel, keeping the bottle inverted and its mouth under water until it has been corked.

The gas so collected can be made to burn with a faint blue flame by using a burner composed of a cork with a quill or a small glass tube thrust through it. Care must be exercised in changing from the solid cork to the burner, or vice versa, to prevent the gas from escaping. Use a quill which can be closed with a stopper.—PAUL R. RIDER, PH.D.

Finding the Speed of a Worm-Gear with a Bit

IN making some experiments with a small machine it became necessary to use a worm-gear for a transmission. The following method was used to determine the speed required. The shanks of several broken bits were cut off as shown at *A* and connected with the motor by means of flanges, each one in turn. With the use of different sizes of

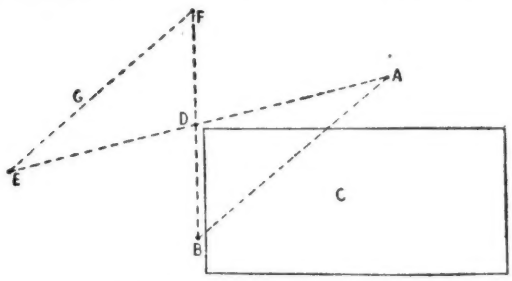


The twist of a bit drives a straight-cut gear for determining required speeds

gear-wheels and bits the speed desired was easily obtained. Such a gear has been used on a larger machine with excellent results.—E. J. BONIS.

Measuring Through Obstacles by the Triangulation Method

IN trying to find the length of a pipe for laying a line under a house or other building it often happens that difficulties are encountered which prevent direct measurements. In such cases the following method may be used: In the illustration the line *A-B* is the one to be measured, *C* being the obstacle that prevents direct measurement. At the point *D* both *A* and

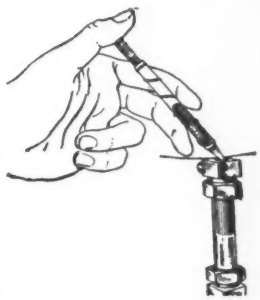


Finding the length of a pipe through an obstacle by the method of triangulation

B can be seen. First, sight from point *A* over *D*, and beyond for a distance equal to *A-D*, to *E*. From *B* repeat the operation, making the distance *D-F* equal to *B-D*. The line *G* when measured will be found to be the same length as the line *A-B*.—PAUL I. KENNEDY.

Making a Small Syringe to Clean Lubricator Glasses

THE small lubricators usually attached to small stationary engines do not as a rule have a drain-plug or valve at the base of the feed-glass for cleaning it. This makes it necessary to "blow back" through the feed-nozzle to empty the oil. I was recently working on a small engine having a lubricator of the above type, and in connection with the lubricator, due to poor run of feed water at times, the feed-glass frequently filled with sediment, making it impossible to see the feeding drops of oil or to know whether it was working.



A small syringe made from a lead pencil

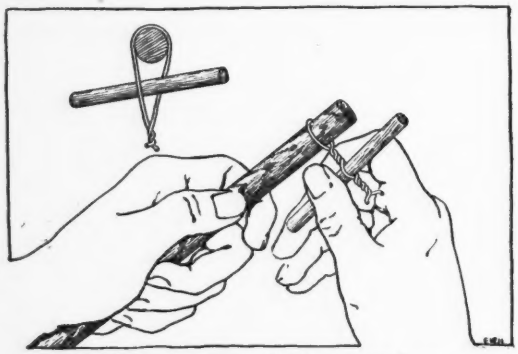
The drawing shows a small emergency syringe made from a lead pencil and a strip of moderately heavy oiled paper. A piece was cut off from the end of the pencil and the lead pushed out to make the nozzle. The other part of the pencil was used as a plunger or piston. It was not necessary to empty the oil from the lubricator in order to "blow back" to clean the glass, for the water and sediment were quickly drawn out by simply removing the small cap nut. The lubricator started as soon as the glass was again filled with the small amount of necessary condensation.—F. W. BENTLEY.

A Coin Used to Close Hole of Broken Oil Window

WHILE out on a pleasure trip with my motorcycle and sidecar I lost the oil window nut and washer on the mechanical oiler and could not run the motor because it would pump the oil out through the opening and not into the motor. Being 30 miles from the nearest means of transportation, I stood around waiting for an automobile or farmer to pass. I put my hands in my pockets and in an absent-minded way pulled out a handful of change. A quarter of a dollar I had seemed just the size of the little oil window. I put it into the place and by tapping the case with the screwdriver to keep it from falling out, made it fit in tightly. It served the same purpose as the window for keeping the oil where it belonged.—OSCAR P. BECKER.

Twisting a Wire When Pliers Are Not Available

IF it becomes necessary to twist a wire around an object to serve as a ferrule, or to draw parts together tightly, and pliers cannot be used to get the desired

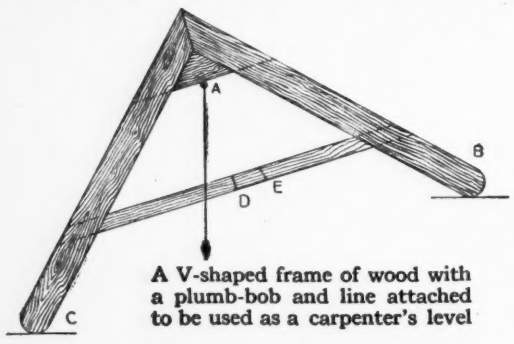


Twisting a loop tightly around an object, using a stick instead of pliers

twist, the method illustrated will be found satisfactory. It is only necessary to make a loose loop around the part for the band and to apply a stick.—A. S. THOMAS.

Making a Plumb-Bob Level of a Wood Angle

THIS simple form of a plumb-bob level is very efficient and is easily constructed of material found on any building job. It consists of two pieces of wood fastened to a block to form approximately a right angle. A piece is fastened firmly across the two legs of the angle, and a staple, nail or screweye is put in at the



A V-shaped frame of wood with a plumb-bob and line attached to be used as a carpenter's level

point *A*. Fasten to this a string and plumb-bob. Place the frame on two surfaces as shown in the drawing. Make a mark on the crosspiece at the point where the plumbline crosses. Reverse the frame so that the leg *B* rests on one support and *C* on the other and make a mark on the crosspiece where the line crosses. Measure off a point halfway between these two marks and make a permanent mark *D*. This mark will be crossed by the plumb-line when the frame rests on a perfectly level surface.—B. FRANCIS DASHIELL.

Saving Scrap-Gum When Making Tire Repairs

IN repairing pneumatic tires save the scrap-gum. This can be returned to the factory for credit. The value of this material when returned depends largely upon the condition of the rubber. The gum should be kept separate and free from foreign material. When unrolling gum or fabrics for cutting, unroll them so that the holland is on top; then roll the holland back. Do not destroy the holland, as it may be used to cover tube-plates.

Measuring Circumference with Typewriter Spacing

HAVING occasion to measure a circumference that figured out to tenths of an inch, and not having a rule marked to these divisions, I tried the following means of overcoming the difficulty. Going to a typewriter, I made a row of periods, with each tenth one a comma to show full inches, thus:

,.....1,.....2,.....3,

This gave me a rule marked in tenths, also one that could be bent around shafting, collars, etc. As nearly all typewriters make ten spaces to the inch it is an easy matter to accomplish what seems to be a difficult job.—J. CLAUDE CREWS.

A Durable Dead Black for the Inside of Cameras

THE dead black used by most camera manufacturers, the composition of which has long been considered to be a secret of the trade, is a mixture of lamp black and celluloid solution, the latter being far superior to shellac varnish for the purpose. The lamp black is stirred in and thoroughly incorporated with the liquid. There is no difficulty in making the celluloid solution. Old photographic films may be cleared of adhering gelatine, washed and dried, then shredded as fine as possible.

A solution is then made by dissolving acetate in amyl to the consistency of syrup and thinning down the acetone with it.—H. G. GRAY.

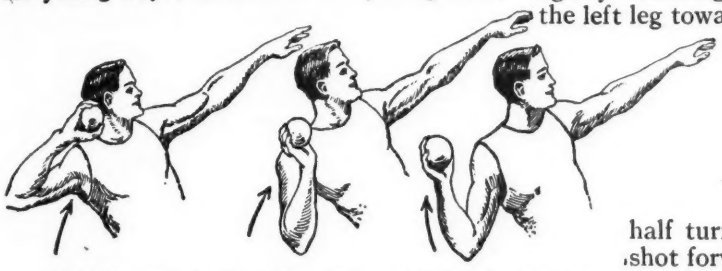
Winning an Athlete's Laurels

III—Putting the shot, throwing the hammer, and hurling the javelin

By Albert B. Wegener

A technical instructor and director of athletics of twenty-seven years' experience

THIS class of events includes all throwing, and putting heavy objects. They are: the shot put, hammer throw, discus throw, javelin throw, and heavyweight throw. For the shot put, a heavy lead or iron ball, weighing 8 lb., is used for young boys, 12 lb. size for young men, and 16 and 24 lb. for large men. These balls resemble a cannon ball.

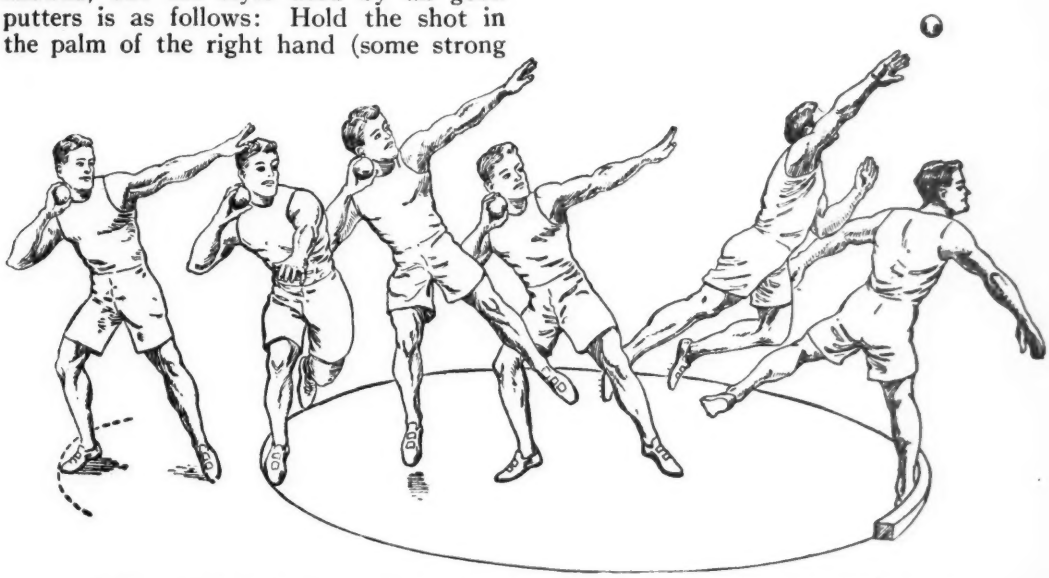


Hold the shot in the palm of the right hand with the shot resting against the neck and balance on the right leg

A right handed putter should pick up and carry the shot with the left hand so as not to give all the work to the putting arm. Any kind of a preliminary run is allowed, but the style used by all good putters is as follows: Hold the shot in the palm of the right hand (some strong athletes hold it higher up on the ball of the thumb and fingers). The shot rests against the neck, elbow of the supporting arm extended at the side. Balance on the right leg with the left arm and leg extended toward the front of the circle, the left foot lightly touching the ground. Then swing the left leg toward the right; kick it toward the front of the circle and at the same time hop on the right foot. Alight on both feet in the middle of the circle, then jump quickly forward from both feet, making a half turn to left and thrusting the shot forward and upward, alighting on the right foot against the toe block. Make the movement vigorously and do not make the turn too soon (while hopping).

The shot must be put from the shoulder with one hand only, and it must never be brought behind the shoulder.

In the middle of the circumference of the circle, at the front half, place a stop-board,

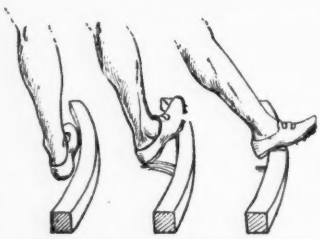


Swing the left leg toward the right, kick it toward the front of the circle and hop on the right foot. Alight on both feet in center and jump forward, making a half turn while thrusting the shot forward and upward alighting on the left foot against the toe block

and fasten it to the ground. In making puts, the feet of the competitor may rest against but not on top of this board.

A fair put is one in which no part of the person of the competitor touches the top of the stopboard, the top of the circle, or the ground outside the circle.

The measurement of each put is taken at the circle from the nearest mark made by the fall of the shot to the inside of the circumference of the circle on a line from such mark made by the shot to the center of the circle.



In the center at the side a stop-board is placed

Foul puts and letting go the shot in making an attempt are counted as trial puts without result. It is a foul if the competitor steps on the circle, or leaves the circle before his throw has been marked.

Each competitor has three trial puts, and the best five, three more. Each competitor is credited with the best of all his puts.

Beginners should first practice the "foot work," without the shot. When starting to use the shot do not try to put it as far as you can, but concentrate upon form. Gradually increase the distance of the put. Do only ten or a dozen puts a day. To prevent wrist sprain wear a wrist bandage when putting. Do not try to get an easy, graceful action; the best putters work with snap.

Hammer Throwing

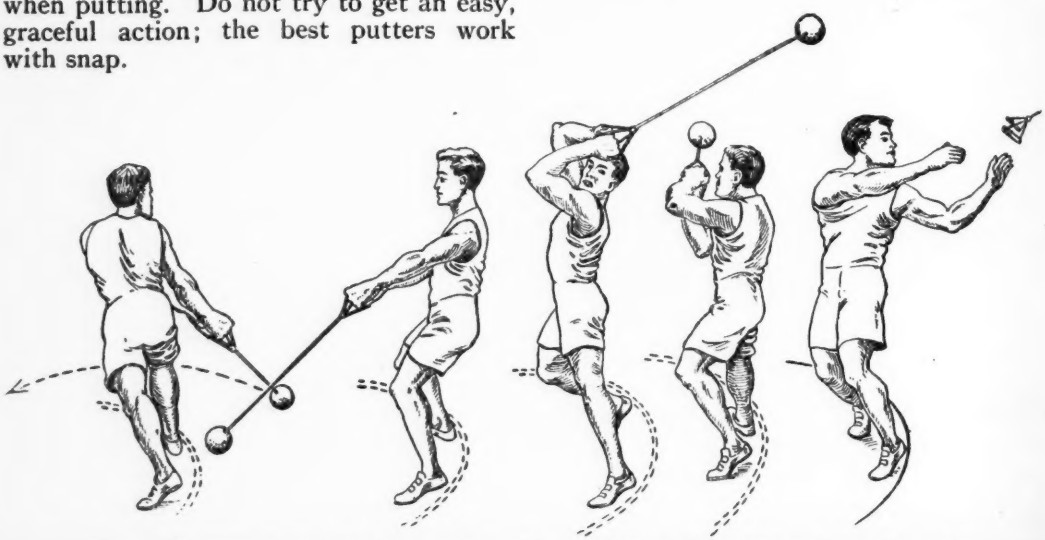
This event is done with an object like a shot to which is attached a wire handle and grips. Like the shot it must be thrown from a 7-ft. circle.

It is a dangerous sport and should not be introduced unless spectators can be kept 200 ft. away. The usual weights of hammers are 12 and 16 lb.

There are two styles of throwing: The no-turn style and the turn style. For the no-turn style, stand with the feet 1½ ft. apart, heels near the front of the ring and the back in the direction in which the throw is to be made. Place the hammer head on the ground well to the right of the circle. Start the swing to the left at arm's length. Circle the hammer diagonally around the head two or three times, then hurl it backward and upward at an angle of 45 deg. There may be some difficulty in keeping the balance after the throw. If this cannot be overcome, the thrower should stand nearer the center of the circle so as to allow for a backward step if necessary.

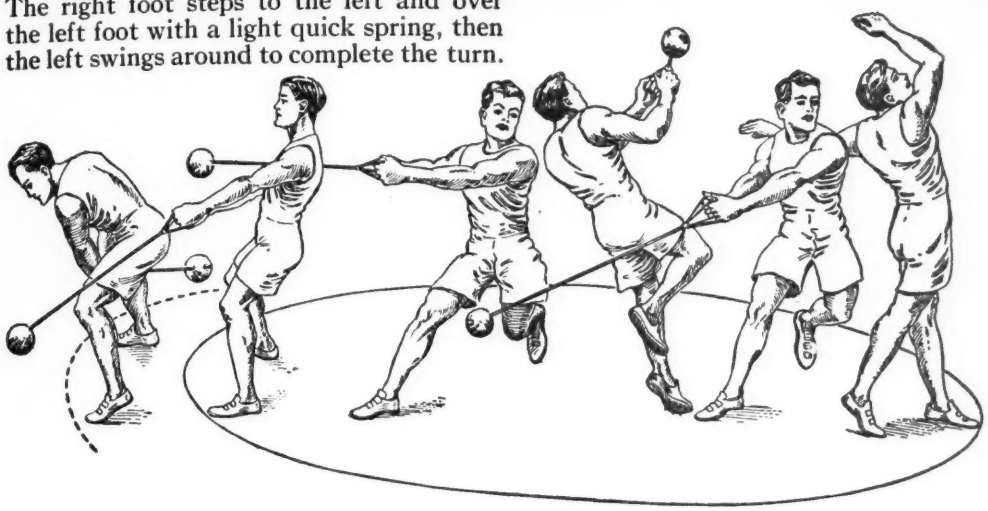
For the turn style, the thrower stands in the center of the circle in the attitude described. After two or three swings around the head the thrower turns with further swings (one, two, or three) and then hurls the hammer. These turns give a great impetus to the throw, but they are difficult.

The turn is made as the hammer swings up to the left. It is a complete turn. The



Place the hammer head on the ground well to the right of the circle and start the swing to the left at arm's length; circle the hammer around the head and hurl it backward

stepping action during the turn is fast. The right foot steps to the left and over the left foot with a light quick spring, then the left swings around to complete the turn.



The stepping action during the turn is fast; the right foot steps to the left and over the left foot with a light quick spring, then the left swings around to complete the turn

All throws, to be valid, must fall within a 90 deg. sector marked on the ground.

A fair throw is when no part of the body of the competitor touches the ground outside the circle.

It is also a foul if the competitor steps on the circle or leaves the circle before his throw has been marked.

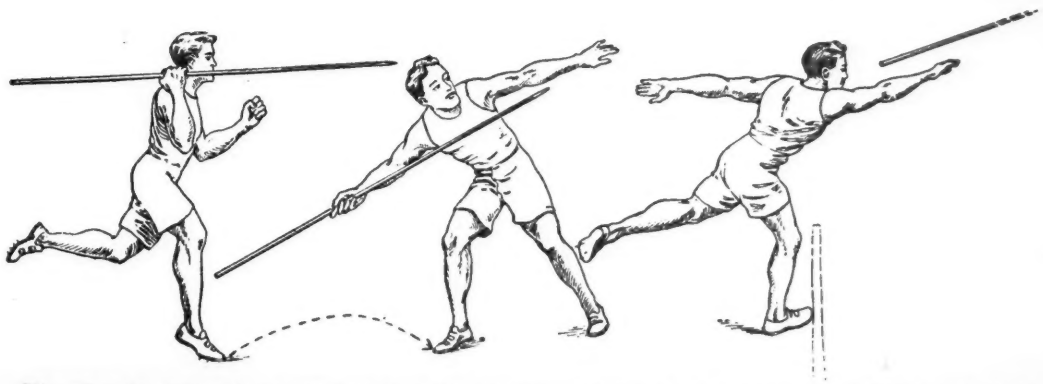
Each competitor has three trial throws, and the best five, three more. Each competitor is credited with the best of all his throws.

The measurement of the throws is from the nearest edge of the first mark made by the head of the hammer to the inside circumference of the circle on a line from such mark made by the hammer to the center of circle.

Letting go of the hammer in an attempt, or touching the ground outside the circle with any portion of the body while the hammer is in hand, constitutes a foul throw, which is not measured but which counts as a throw.

In hammer throwing, if the hammer breaks while in the air, it is not considered a throw.

Practice throwing three times a week, and on the other days do some sprinting, jumping and jogging. Beginners should not attempt the throw with a turn until familiar with the no-turn style. In starting to learn the turn do so without the hammer. After a while use some light object, and then gradually increase the weight until the full weight is reached.



Throwing the javelin is no different from throwing any other object of the same weight except that it must be thrown so that the point strikes the ground first before any part of the staff touches

After you are accustomed to the turns, daily practice should be as follows: Some jogging to warm up; throw without a turn; then with one, two, and three turns in succession, but without trying for distance. Finally try for distance.

Throwing the 56-lb. weight is a clumsy and uninteresting event, but is still used by some athletic clubs. There are two kinds, (1) for distance, and (2) for height. The distance throw is really a clumsy hammer throw. Stand in the center of the circle with legs spread. Place the weight in front on the ground. Grasp the handle and swing the weight backward between the legs, then forward and to the right of the right leg. From there swing it to the left and make a turn, as in the hammer throw, and hurl it. The throw for height is started like the above, then backward between the legs, and then upward to the pan.

In making his throw, the competitor may assume any position he chooses and use both hands.

Foul throws and letting go the weight in an attempt count as trial throws without result.

It is a foul if the competitor steps on the circle, or leaves the circle before his throw has been marked.

Special Rules for Distance

A fair throw is one where no part of the body of the competitor touches the top of the circle or the ground outside the circle.

The measurement of each throw is taken at the circle from the nearest mark made by the fall of any part of the weight or handle to the inside edge of the circumference of the circle on a line from such mark to the center of the circle.

Each competitor has three trial throws, and the best five, three more. Each competitor is credited with the best of all his throws.

Special Rules for Height

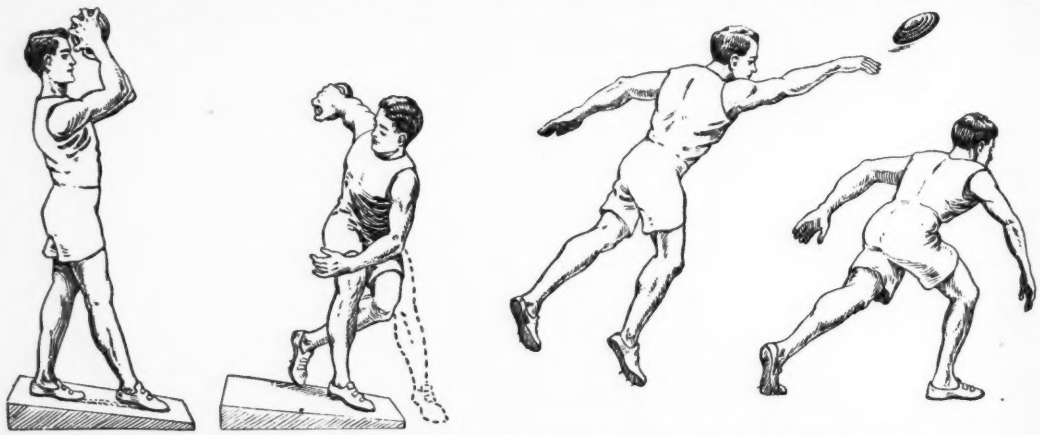
A barrel head 3 ft. in diameter is suspended horizontally in the air.

The field judges determine the height at which the barrel head is to be fixed at the beginning of the competition, and at each successive elevation.

A fair throw is one where no part of the body of the competitor touches the ground outside the circle before the weight touches the barrel head, and where any part of the weight or handle touches any part of the barrel head.

The measurement of each throw is from the ground perpendicularly up to the lowest part of the barrel head.

The method of competition is the same as in the running high jump.



The ancient discus thrower stood on a pedestal much like an indoor pole vaulting block, with the right foot forward and at the lower part that is inclined in the direction of the throw

Throwing the Javelin

This ancient Greek event has been added with the revival of the Olympic games, but is not very popular. This is not different from throwing any other object of the same weight, except that the javelin must be thrown so that the point strikes the ground before any other part. In the style mostly used, the javelin is grasped at the middle, and held with bent arm above the shoulder. Take a fast 15-yd. run. Just a few feet from the toe-block take a hop with the right foot (for a right-handed

thrower), then plant the left foot forward and a little to the left, throw and immediately spring from the left foot forward and alight on the right foot just back of the toe-block.

A full-arm swing should be developed, as in distance throwing with a base ball. Practice for this event should be graduated and moderate so as not to strain the arm.

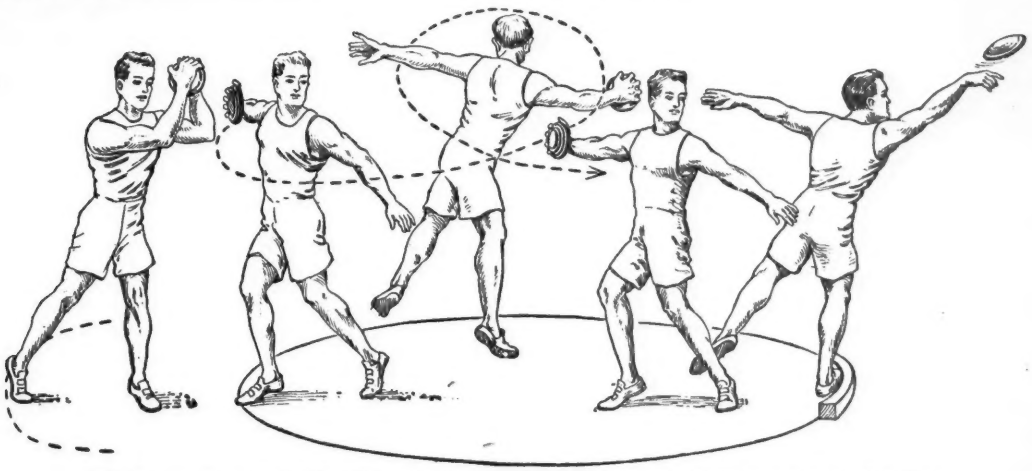
The throwing takes place from behind a scratch line properly marked, which is a board 2¾ in. in width and 12 ft. in length, sunk flush with the ground.

The javelin is held by the grip, and no other method of holding is permissible.

No throw is counted in which the point of the javelin does not strike the ground before any part of the shaft.

weight event. The old Greek style has been repeatedly tried, but it is so awkward that it has been discontinued even from Olympic meets. The A. L. N. A. still retains it in their rules but it is doubtful if it is ever used.

The technic of the ancient style is to stand on a pedestal much like an indoor pole-vaulting block, with the right foot forward and at the lower part, that is, inclined in the direction of the throw. Hold the discus with both hands above the left shoulder, then bend into the classic pose with the discus in the right hand and arm extended backward; then swing the arm forward and spring from the right foot, hurling the discus and alighting on the right foot.



In the modern style the discus is thrown from a circle, in which you stand with the legs spread, the right foot at the back of the circle and the left toward the front

The throw is measured from the spot at which the point of the javelin first strikes the ground, to the scratch line or the scratch line produced.

Each competitor has three trial throws, and the best five shall have three more. Each competitor is credited with the best of all his throws. The thrower must not place his foot or feet upon the board. In javelin throwing the competitor must not cross the line until his throw has been marked. In throwing the javelin, if the javelin breaks while in the air, it is not counted as a trial.

An unlimited preliminary run is allowed (about a 15 yd. run is usually taken).

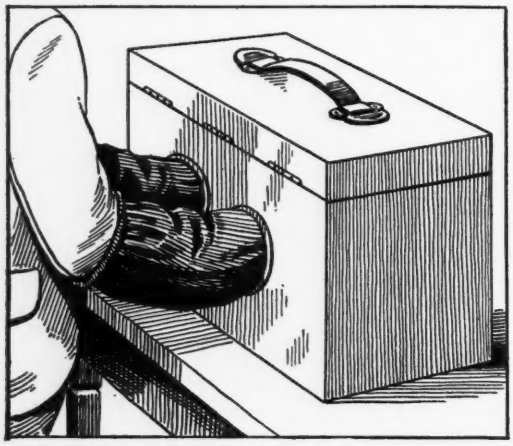
Discus Throwing

This event is also one of the ancient Greek events and in its modern form is considered by some the most attractive

In the modern style it is thrown from a circle 8 ft. 2½ in. in diameter. Stand with the legs spread, the right foot at the back of the circle and the left toward the front. Grasp the discus with the right hand, steadied with the left. Swing it backward to arm spread position. While holding it in this position leap toward the front of the circle from the left foot, make a full turn to the left, alighting on the right foot, replacing the left foot on the ground toward the front of the circle in the spread position, then again leap toward the front of the circle with a half turn and hurl the discus, alighting on the right foot at the front of the circle. Some athletes make two or three turns before throwing. Although that gives more impetus to the throw, the danger to bystanders is greater. The rules are the same as for the hammer throw, except that the circle is larger.

Changing Bag for the Moving Camera Operator

THE traveling motion-picture camera man must carry his tripod, tilting and panoramic heads, camera, magazines, cranks, masks, dissolvers, fade-outs, filters,



Holes are cut in the side of the camera box and cloth sleeves provided in the openings

etc., and in addition to all this, a changing bag. With such an outfit, and often more, he welcomes any scheme to lighten or dispense with any portion of the equipment. One cameraman, a moving picture operator, is not bothered with a changing bag since he has had his camera case altered, as illustrated.

The case is made light-proof and two round holes are cut in the side of the box. Into these holes are fastened sleeves of heavy black light-proof cloth with elastic bands sewed into the outer extremities. This enables the operator to put both magazines and films in the carrying case, which is then closed and locked to prevent accidental opening. He then inserts his arms in the black sleeves, reaches into the carrying case and changes the film with no danger of its being fogged or light struck.

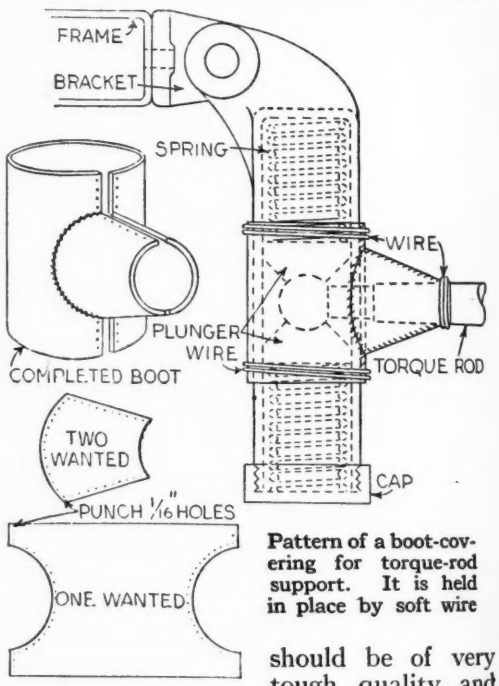
When the box is in use as a carrying case the cloth sleeves are tucked inside and serve as a cushion or pad to protect one side of the camera. The holes do not interfere with the value of the case, or its appearance, if it is properly made.

This same general plan can be worked out by anyone in connection with a view-camera and its carrying case. The practicability, however, depends on the size and shape of the case in relation to the size of the plates used, and the ease with which such a case can be made light-proof. In most instances of this kind a new case would probably be desirable, if not absolutely necessary. The plan is of little value to anyone but the itinerant photographer.

Covering an Automobile Torque-Rod Support with Leather Boot

IT IS necessary to keep all working parts on an automobile covered as far as possible to prevent dirt from entering. One of the parts which can be readily covered is the front support of the torque-rod. The torque-rod serves the purpose of relieving the strain on both the rear axle and the springs when the car is started; consequently the ultimate result of a faulty torque-rod is a break-down on either axle or springs. Most of the torque-rod trouble may be traced to the dust and grit entering the working parts.

The illustration shows the shape of a boot for covering this part. It is in the form of a tee, the vertical portion covering the opening in the support-casing and the horizontal part covering the end of the torque-rod. In order to insure the correct cutting of the pattern it is best to cut and fit a paper one for a trial. The leather



Pattern of a boot-covering for torque-rod support. It is held in place by soft wire

should be of very tough quality and well soaked in oil a few hours before being cut. A strong and thoroughly waxed twine is used for making the stitches at the joints.—ADOLPH KLEIN.

The Amateur Electrician

And Wireless Operator

The Construction of a Fifty-Volt Storage-Battery

THE increasing use of the audion bulb for wireless work brings up a power problem that is by no means easy of solution. The necessity for using 40 or more volts for the amplifying circuit has troubled many of the experimenters who would like to use this efficient form of detector. The small flashlight batteries are in common use more particularly for the portable sets, but while they serve their purpose very well, their first cost and subsequent replacement make them out of the question in many instances. The cost of these dry cells is about 30 cents and it is necessary to use 8 or more. Although the audion draws but a small fraction of an ampere, the cells must be discarded before any reasonable returns are made on the investment, as the dry cells deteriorate regardless of whether they are used or not. The fact that the audion requires such a small amount of current suggested that it is possible to construct a storage-battery that will require no replacements and that can be quickly charged at a small cost.

Two general forms of a storage-battery are given, one for charging from the electric mains having a current in excess of 60 volts and the other for charging from a Bunsen, sal ammoniac or bichromate cell. Each battery consists of 24 cells made of test tubes having an outside diameter of 1 in. and a wall 3/64 in. thick, the length being about 6 in. The fillers for the test tubes are made of lead tubing 3/8 in. outside diameter with a wall 3/32 in. thick. The lead tubing is standard stock in assayers or chemical supplies and the test tubes are standard stock. After procuring the 24 test tubes, proceed to make a frame *A*, Fig. 1. This style of battery is for use on the ordinary direct current electric main. Lay out and mark the places for the holes and bore them with an expansive bit to make a sliding fit for the test tubes. The flared end of the tubes will keep them from slipping through. It will require some care in boring the holes to prevent the board from splitting, and it may be necessary to first bore a small hole, say with a 3/16-in. bit, for the lead screw of the expansive bit. If the cells are to be charged from primary batteries the construction, of course, is as shown in Fig. 2.

To make the elements for the battery as shown in Fig. 1, cut 23 pieces of the lead tubing, each 12 in. long, as shown in Fig. 3,

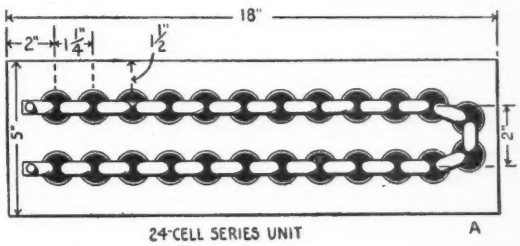
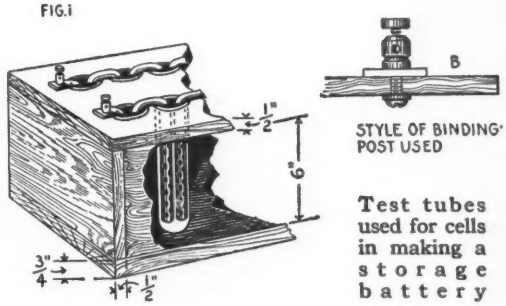


FIG. 1

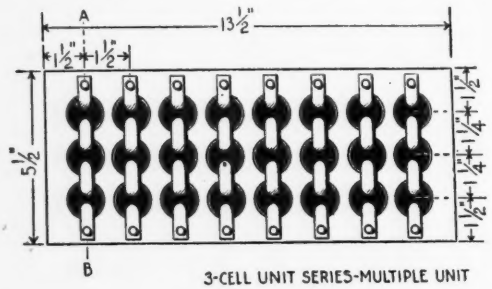


Test tubes used for cells in making a storage battery

and two pieces, each 6-5/8 in. long, as shown in Fig. 4. The 23 pieces are perforated with a 1/8-in. drill, numerous holes being made for a distance of 5 in. from each end. Then the pieces are bent into a U-shape as shown. The two short pieces are drilled for 5 in. of their length in the same manner and the undrilled end is bent over in the shape of an L. Use a sharp drill running

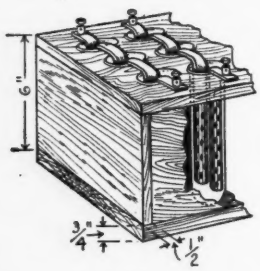
very fast for making these holes. The three-series eight-parallel battery shown in Fig. 2 requires 16 of the U-shaped pieces and also 16 pieces of the short L-shaped length.

The filling for the lead tubes is made up of a thick mixture of red lead and dilute



3-CELL UNIT SERIES-MULTIPLE UNIT

FIG. 2



This diagram shows the arrangement of the cells and lead fillers for use where the battery is to be charged with a current from other batteries

sulphuric acid—one part acid to two parts water. Be careful in making the dilute solution of acid. Always pour a small quantity of the acid in the water and stir vigorously. Never add water to the acid. The paste mixture should be about as thick as putty. As there must be different mixtures in each leg of the lead tube the other mixture is made up in the same manner except that yellow lead—litharge—is used instead of the red lead.

One leg of each tube is stuffed full of the red lead mixture and its mate with the yellow. All of the double elements are treated in a like manner. In making up the smaller lengths fill half their number with the red lead and the other half with the yellow; thus for the 24-series unit there will be two of the short tubes used—one filled with red lead and the other with yellow lead. For the 3-series, 8-parallel unit there will be 8 short pieces filled with red lead and 8 with the yellow lead. In either case force the paste in so that it will be pushed out through the holes, then scrape off the excess so that it presents a smooth surface.

Before the elements are assembled they must be treated for charging. One method is to charge the assembled battery and then discharge in the opposite direction. This operation should be repeated four or five times. Another way is to lay the legs filled with the red lead in a strong solution of chloride of lime, or a solution of nitric acid, or sulphuric acid—one part acid to two parts water. Allow the elements to remain in the solution until they are somewhat roughened.

If the latter method is used the battery is ready to assemble. This is very plainly shown in the illustrations. In building up the battery shown in Fig. 2 a single red lead element is placed in the end test tube and one leg of a yellow lead double element is introduced into the same test tube, the other leg being placed in the second tube. Continue by using one more double element and finish with a single yellow lead element. This makes each tube with one positive element and one negative, and one unit of three cells is complete in the series. The other 7 units are built up in the same manner. The illustration Fig. 1 shows plainly how the 24-cell unit is made up, starting with a single element and finishing with the opposite single element, the intermediate ones being filled with the double elements.

Two binding posts are used on the 24-cell, as shown. The screws are passed through the frame and through a hole in the end of the element. This is plainly shown in

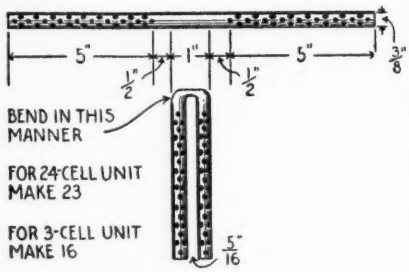


FIG. 3

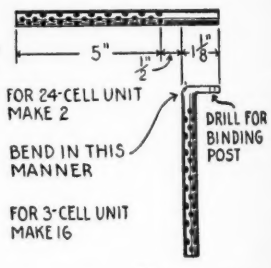


FIG. 4

The elements are made of lead pipe cut to the right lengths, bent into shape for entering the cells and drilled for holes. Each tube has one positive and one negative element

B, Fig. 1. For the 3-series, 8-parallel unit there are required 16 binding posts, two for each unit. The posts are fastened in the same manner as for the 24-cell unit. The reason 16 posts are needed is that the cells must be connected in parallel for charging

and then disconnected and connected in series for use.

The electrolyte is made of a mixture of sulphuric acid and water. Commercial acid of about 1.835 specific gravity should be diluted with clean rain or distilled water. Mix the solution in some kind of a glass or glazed crock, using the proportion of 1

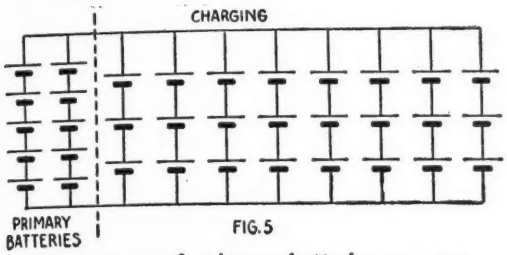


FIG. 5

Two groups of primary batteries are connected in parallel and eight of the storage units

part acid to 4 parts water. The resulting mixture should be about 1.180 specific gravity. Always pour the acid into the water in a very small stream, stirring vigorously at the same time. When the solution has cooled pour a sufficient quantity into each tube, making the level come to within ½ in. of the top of the tube when the elements are in place.

In usual practice 40 to 60 ampere-hours capacity is allowed for each square foot of positive plate, measuring both sides of the plate. The thickness of the plate, unless great, is disregarded. It is well to know that the electrolyte penetrates only about 1/16 in., so that any excess of ⅛ in. in the thickness of a plate is solely for mechanical strengthening of the plate and is useless in an electrical capacity. As the elements of these batteries are round, only the surface can be figured. The tube being ⅜ in. in diameter and 5 in. long makes a surface area of about 6 sq. in. In allowing 50 amperes per square foot, the ampere-hour capacity of one cell of this battery will be about 2. The average charge or discharge voltage is about 2 and the watt-hour capacity of each cell will be 4, thus making a 24-cell battery a 96-watt-hour capacity. While it is possible to draw more current from the battery than is rated, yet it is not advisable to do so, as that ruins it quickly.

Each cell of storage-battery, regardless of its length, width and number of plates, will give after a full charge about 2½ volts, and the voltage required to charge any number in series is equal to 2½ times the number in series. Thus, the 24-series battery, Fig. 1 (since they are all connected in series) will require 60 volts. In the 3-series, 8-parallel battery, three cells are in series and the voltage will be 7½. Usually more voltage than is actually necessary is provided—about ½ to 5 volts per group. This extra voltage lessens the danger of having the storage cell discharge back into the charging source, the voltage of the storage cell exceeding that of the charging source. The 24-series battery requires about 62 volts and the 3-series, 8-parallel battery requires 8 volts.

To charge a storage-battery with its maximum ampere-hour capacity—that is to say, to charge an 80-ampere hour battery with 80 amperes for one hour—would probably ruin it. The best rule to follow is to charge at the 8-hour rate. Thus a battery may be charged in 8 hours, which is the normal rate, or it may be charged in 7, 6, 5 or even 4 hours. In charging this battery the 8-hour or normal rate is determined by the cell capacity divided by the 8 hours, which would equal 25. That is to say, each cell is to be charged with ¼ ampere for 8 hours. The 7-hour rate is 2÷7, and so on; but under no circumstance should this or similar small batteries be charged at less than the 4-hour rate. Another good rule to follow is to allow a charging rate of .04 amperes per square inch of positive surface. It is apparent that the foregoing methods of calculation can be used to find the capacity and the charging rate of any size storage cell in common use.

The resistance necessary to be placed in

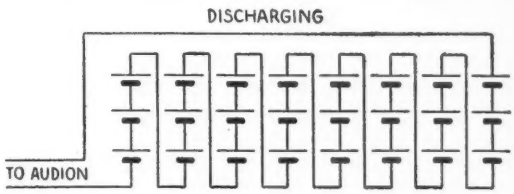


FIG. 6

When used in a discharge, connections from the battery binding posts are made in series

series with the battery on a 110-volt direct current main to lower it to 62 volts, the amount necessary for the 24-series battery, will be 192 ohms, for the normal 8-hour rate. In using current from a 220-volt direct current main the same procedure may be carried out to determine the resistance necessary to reduce the current to 62 volts. This will require 632 ohms for

the 8-hour or normal rate. With the 3-series, 8-parallel battery the most convenient way is to charge it with bichromate batteries. These cells are cheaply and easily made of zinc and carbon scrap. They have a potential of about 2 volts and are high in amperage. Connect the two groups of 5 in series and place the two groups in parallel. Also connect the 8 units of storage-battery in parallel and connect with

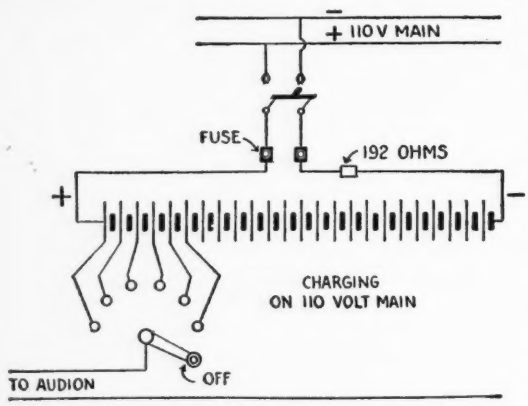


FIG. 7

When the storage-battery is used on an audion it is necessary to supply an end switch

the bichromate batteries. Be sure to connect the zinc element of the bichromate cells with the negative of the storage-battery. This is shown in Fig. 5. This method of connecting the storage cells in parallel series is only for the purpose of charging. When used on the discharge they must be disconnected at the binding posts and connected in series as in Fig. 6.

The cells during the charge should give off gas. Toward the end of the charge they should gas freely. A failure to gas is a sure sign something is wong. An insufficient voltage or a short circuit in some one cell may be the trouble. When the negative begins to gas freely, or when the electrolyte turns to a milky color, it is a good sign that the cells are charged. A slight overcharge will do no harm. An overcharge is frequently used to clean out the elements.

The battery fully charged will give a voltage of about 60 when connected in series. To provide the most efficient voltage for an audion it is necessary to supply an end cell switch, as shown in Fig. 7. The voltage will soon drop to about 50 where it remains practically for the life of the charge. Do not discharge to a lower voltage than 42. A light charge should be given every two weeks.

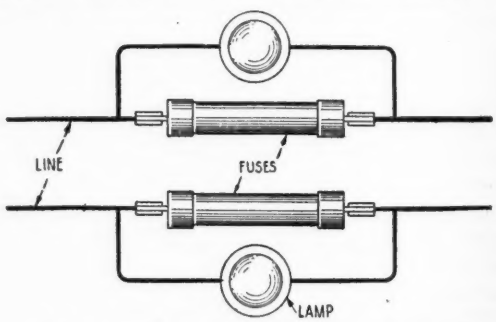
A New Wireless Station on the African Coast

A NEW wireless station has been erected on Cape Juby, on the African coast. In cases of need at sea the service is available for ships in distress. As the installation on Teneriffe Island is less than 100 miles from the Cape Juby plant, communication with the Canary Islands is possible and, through them, with the Spanish mainland.

Cape Juby is a sandy and practically barren projection into the Atlantic Ocean some 67 miles from the Island of Fuerteventura of the Canary group, and in the same latitude. It is a part of that section of the western Sahara which extends along the Atlantic coast and connects the Mogador district with that of the Rio de Oro. The last named was recognized as Spanish territory by the treaty of Paris of 1900. Water is very scarce on the cape, although it can be obtained in the ravines by sinking wells. The interior region is said to support great numbers of sheep and to produce excellent crops of wheat, barley and corn. The ocean fisheries at this point are very abundant.

A Light Signal to Designate a Blown Fuse

WHERE there are a number of fuses on one block and the block is placed in a dark corner, a blown fuse is hard to locate without a light or pocket flashlamp. To eliminate the wiring for a lamp and have a light ready to locate the burned-out fuse the arrangement shown was installed. Each of the fuse-cartridges in the block was shunted through a low candlepower lamp. Such a lamp will not affect the rating of a



A low candlepower lamp glows when the fuse is blown and until another is installed

fuse to any extent and will not glow until the fuse is blown.—JESSIE C. HASKELL.

Testing Bell Circuits with Ordinary Dividers

IN making tests on a bell circuit it is usually necessary to remove the insulation or make connection only where the wire is bared; however, the method illustrated here can be employed without harm to the insulation. An ordinary pair of dividers is used, their points being thrust

The points of the dividers are thrust into the insulation until they touch the wire

through the insulation until they touch the wire within. When the divider-points are removed the tiny holes they made will close sufficiently so that the insulation will be as perfect as before.—EDWARD R. SMITH.

Changing a Direct Current Bell into an Alternating One

TO change a direct current bell into an alternating one on which a step-down transformer is used, make the connections in such a manner that the two poles of the magnet go directly to the binding posts of the bell; next connect in series with a 32-candlepower carbon filament lamp or the secondary of a transformer and adjust the clapper spring.—AURELIO SIERRA, JR.

How to Make a Solderless Joint on Wire

IT is difficult to make a good wire connection when solder is unavailable, however with the following method a very good joint can be made. Scrape about 6 in. of the wire to be connected, making sure that all rust or grease is thoroughly removed, then twist the wires tightly together. A piece of tinfoil about 1 in. wide is then wrapped tightly around the twist. Be careful not to tear it. Then apply another layer or two of the foil and wrap it over with tape, so that no corroding substance or rain can enter the joint. Pull the tape very tight so as to insure a good connection between the tinfoil and the wire. Then paint with asphaltum. This method is only to be used in case of emergency.—ALEXANDER V. BOLLERER.

Precise Resistance Measurement by the Voltmeter-Ammeter Method

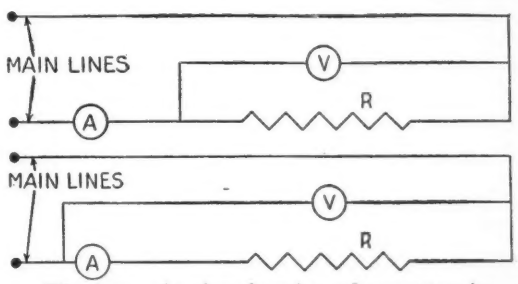
THIS article is intended for the everyday shop man and the average electrician. The measurement of resistance can be made very precise by the method given.

Two important points are: To be sure that the instruments read correctly to .1 of one per cent, and to take ten or more readings for each measurement. The resistance for each reading should be computed and the average taken of the several readings for the final value.

The theory of this method depends upon Ohm's law: $E=IR$. The accuracy of the results depends upon the readings and the manner in which the instruments are connected with the resistance. A high resistance can not be connected in the same way as a low one.

It is well to know whether to connect the voltmeter across the resistance, or the resistance and ammeter together. For this reason the nature of the sample should be studied before an attempt is made to measure it.

For example, let a voltmeter be connected across a high resistance only. The ammeter in the circuit will record the current through both the resistance and the voltmeter, as they are in series with the ammeter. There will be a very small current flowing. If the resistance to be measured is greater than the voltmeter's resistance more current will flow through the voltmeter than through the resistance.



Diagrams showing location of ammeter in line for measuring resistance accurately

In this case (problem 1) the ammeter should be connected in series with the resistance. The voltage drop across the ammeter is very small compared to that in the resistance. The per cent of error will be very small when measured.

Now consider a low resistance with a large current flowing (problem 2). First, notice

the connections in first diagrams. The ammeter will read correctly, but the voltmeter records the voltage-drop across both.

This arrangement is very much in error because the drop in the ammeter is greater than in the resistance. In problem 2 the voltmeter is connected across the resistance only, as in second diagram. The current flowing through the voltmeter will be very small compared to that flowing in the resistance. The per cent of error in the ammeter is small. The voltmeter in the connections shown will read correctly.

A simple problem may serve to make clear the described method. What is the correct resistance of a 40-watt lamp? The ammeter is a milliammeter, resistance of .045 ohm. The voltmeter has a resistance of 15,000 ohms. The voltmeter reads 110 volts and the ammeter .3636 amp.

SOLUTION:

Problem 1. VOLTMETER ACROSS RESISTANCE.

The current through voltmeter, by Ohm's Law, equals

$$\frac{110}{15000} = .00734 \text{ ampere.}$$

The current through resistance equals

$$.3636 - .00734 = .35626 \text{ ampere.}$$

Per cent of error,

$$\frac{.0073}{.35626} = 2.43 \text{ per cent.}$$

The voltmeter records correctly.

Problem 2. VOLTMETER ACROSS RESISTANCE AND AMMETER.

Voltage across ammeter,

$$.3636 - .045 = .1638 \text{ volt.}$$

Voltage across resistance,

$$110.0000 - .1638 = 109.8362 \text{ volts.}$$

Per cent of error,

$$\frac{.1638}{109.8362} = .149 \text{ per cent.}$$

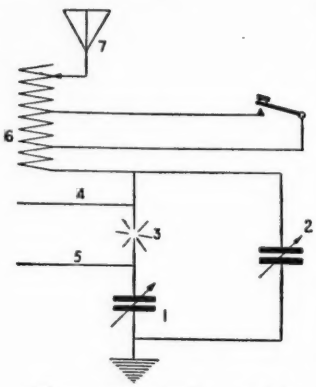
The ammeter records correctly.

The ammeter in problem 1 reads too high by 2.43%, or about 1.51 ohms. From the arrangement in problem 2 the voltage reads too high by only .149%, or an equivalent of .0595 ohms.

From the foregoing method a rule may be summed up as follows: When measuring a high resistance, connect voltmeter across resistance and ammeter both; when measuring a low resistance, use voltmeter across resistance only.—T. E. MARTIN.

Increasing the Efficiency of the Poulsen Arc Generator

IN THE past the Poulsen arc generator of undamped or sustained waves has usually been used directly in series with the antenna in which it operates. The efficiency of this arrangement is variously stated as from 15 per cent to 50 per cent, depending largely upon the constants of the circuits and the details of design of the arc generator itself. The wide use to which generators of this type have been put in the past few years, in the United States Navy and elsewhere, has caused a good deal of study to be put upon the system with a view toward maintaining the highest efficiency. By the addition of condenser and inductance circuits it has been found possible to increase materially the output of a single arc oscillator, and some results have been secured which would appear most surprising to those who are familiar with only the older forms of the apparatus.



New arc circuit which increases the radiation

United States patent number 1,179,353, issued in 1916 to L. F. Fuller, shows one method of increasing the radiation or antenna current produced by an arc generator. As indicated in the figure, the only material change is that of adding the two condensers 1 and 2. The first of these is placed directly in series with the arc 3 (which is supplied with power through the leads 4 and 5 in the usual way), and the second is shunted about the arc and the first condenser. Above the arc and shunt circuit is connected the loading inductance 6, with a small portion arranged to be short-circuited by means of the signaling key; the high potential end of this coil is led directly to the aerial 7. The capacity of the two condensers is adjusted by trial, and depends upon the size of the antenna and the power of the arc. When the best values are used, the antenna current is often more than doubled without using any more power than normally.

The effect of the added condensers is to reduce the effective resistance of the aerial circuit. In the old lay-out all of the antenna current passed through the arc itself, and this of course occasioned large resistance losses. In the new arrangement the larger part of the radiation current passes through the shunt condenser, which has a much lower effective resistance, and the wasted power is greatly reduced. By shunting the condenser 1 with a circuit containing inductance and resistance in the proper proportions, the impedance of the arc circuit is still further increased and still more of the main antenna current forced through the shunting condenser. This causes still further gains in efficiency.

With a 5 k.w. arc the antenna current has been increased 100 per cent by making the condenser 1 equal to and that of the condenser 2 twice the capacity of the antenna. Using a 50 k.w. generator, the current has been pushed up 74 per cent by suitable adjustment of the condensers, and then additionally increased 11 per cent by adding the shunting circuit of inductance and resistance. It is important to keep the inductance of the leads 4 and 5 very small. It would appear that circuits of this sort should be of considerable value in arc working, for not only is the efficency of the system markedly increased but the tuning of the system is made much sharper and difficulties due to the radiation of extraneous wavelengths are cut down.

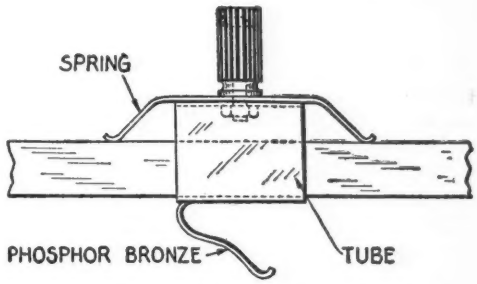
Making a Tuning Coil Slider with a Good Contact

IN making up wireless receiving equipment it is often necessary to have a slider which moves easily and yet makes a good electrical contact. The following describes a type which has been used with satisfaction. A piece of sheet-brass 1/32 in. thick and ¾ in. wide is needed. The length depends on the size of the slider rod, but the dimensions given are for rods 5/16 in. square.

Cut the brass strips to size and bend the square corners 5/32 in. on each side of the middle. Bend two other square corners 5/32 in. from each end. This gives a rectangular tube 5/16 in. wide inside measurement and about ½ in. high. There is left a 3/16 in. space after the rod is in place.

Place the seam at the top and solder a brass strip 5/16 in. wide and 1 ⅝ in. long, lengthwise of the tube. Bend the ends as shown in the sketch so that they will exert considerable pressure on the rod when it is inserted in the tube. Drill a hole for a small machine screw through the spring and tube.

On the opposite side solder a phosphor-bronze strip which should be bent, as

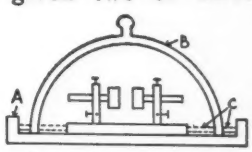


A slider made of sheet brass and a spring to make perfect contact with the coils of wire

shown, to make contact with the winding of the primary. The length of this strip and its width at the point of contact will have to be determined by the builder. It should be long enough, however, to provide sufficient pressure and still not catch on the turns of the coil. For a handle the hard rubber grip from the generator crank of a magneto telephone is satisfactory and may be attached to the slider by means of a machine screw and nut, the screw passing through the hole which has been already drilled in the tube.—D. R. LEWIS.

A Simple Experimental Spark-Gap in a Case

A BASE, *A*, is turned out of wood on a lathe and then given two or three coats of varnish. The inside diameter of this base should be just large enough to permit the glass bell jar *B* to fit snugly in it.



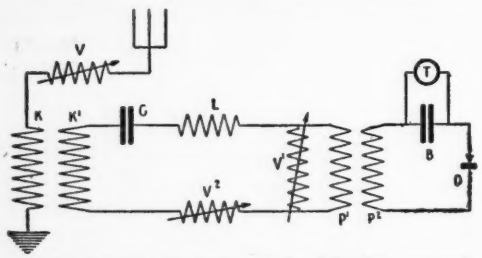
A spark-gap inclosed in an air-tight case

An ordinary spark-gap is mounted on the base and the connections brought through the base and sealed to prevent the leakage of oil.

Enough good transformer-oil *C* is then poured into the base to cover it ¼-in. thick, and the bell-jar is placed in position. This makes the gap air-tight and, by reducing oxidation, aids in producing a humming tone in the receivers.

Increasing the Efficiency of a Receiving Outfit

R. H. RENDAHL'S U. S. patent No. 1,175,472, recently issued, shows how a crystal detector may be coupled to a tuned receiver in such a way that the sharpness of tuning can be changed without affecting the resonant frequency. In older methods of coupling the detector to



The antenna is connected with the ground through the load coil and transformer primary

the resonant circuits, any change in the transformer leading to the detector caused a change in the tuning also. Thus, when the detector was tightly coupled for weak signals with moderate selectivity, 600 meter waves might tune at 40 degrees setting of the secondary condenser; while if the coupling were loosened to tune more sharply the same wavelength might be tuned at only 30 degrees. This inconvenience is eliminated by the use of the arrangement shown in the figure.

The antenna is connected with the ground through the variometer load-coil V and the transformer primary K. The secondary K_1 has in series with it the tuning condenser C, the loading inductance L, the tuning variometer V_2 and the coupling variometer V_1. Across the coupling variometer is connected the primary P_1 which has very tightly coupled to it the secondary P_2. The detector D, telephones T and blocking condenser B are connected as shown. Coil P_1 may be wound in ring form as a layer which lies directly between two other layers connected together to act as coil P_2. When the coupling is as tight as in this case the primary winding acts practically as a simple ohmic resistance, for its inductance is almost entirely neutralized by the opposing currents in the secondary.

The coupling of the detector to the secondary circuit is changed by means of variometer V_1. With this at its maximum value of inductance the greatest amount of energy is fed to the detector, while when V_1 has minimum inductance the potential across the detector is least. Since the coupling variometer is shunted by the almost purely resistive coil P_1, which is not of high resistance, its inductance is not effective in the tuning of the secondary circuit.

Therefore it is possible to withdraw the energy for the detector at any desired rate without having to retune. The loudest signals are usually secured when the effective resistance of the detector is adjusted, by means of V_1, to a value equal to the effective ohmic resistance of the entire circuit without detector. By the use of such an apparatus it is often possible to considably increase the receiving efficiency of the wireless outfit.

Connections for Vacuum Tubes to be Used in Wireless Telephony

IN THE illustration the microphone M is in an intermediate oscillary circuit, which is excited by a generating tube, V. The intermediate circuit is also coupled inductively with a three-electrode tube of large dimensions arranged for amplifying the oscillations occurring in the microphone circuit.

By adjusting the steady potential acting at the control electrode of the second tube it is possible to arrange that uniform oscillations applied to it have no effect on the annode circuit, and then only the microphone variations are magnified. If this be done, the second tube may be made the same size as the first; or the micro-

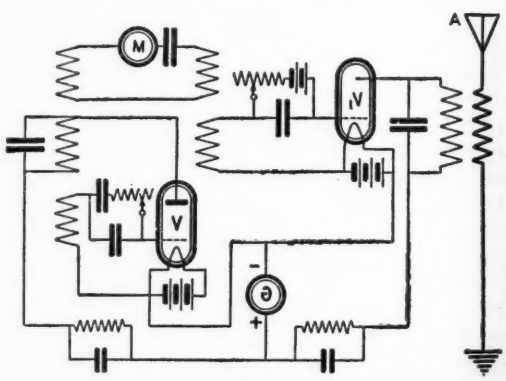


Diagram showing connections for a vacuum generating tube to produce oscillations

phone circuit may be arranged between the two coupled inductances belonging to the generating circuits of the tube V in which case the second tube will not be necessary.

A New Rotary Variable Condenser

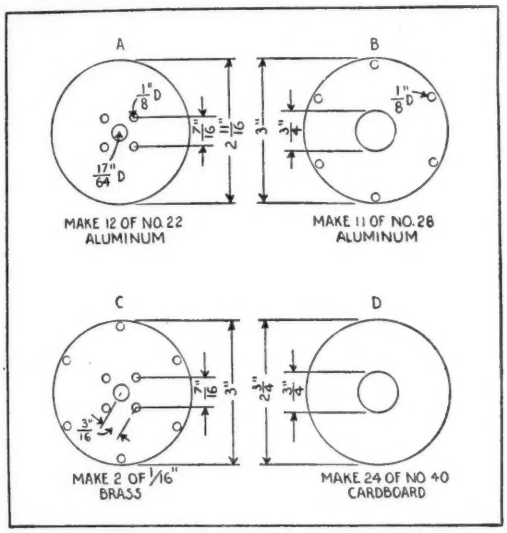
A simplified method of construction within the scope of the amateur

By R. U. Clark, 3d

THE innovation which the author has worked out for building rotary condensers, consists in separating the fixed and movable plates the correct distance from each other by means of a simple lead casting for each set.

The instructions outlined herewith make it a simple matter to construct two excellent rotary condensers, at a small cost and with little labor. The tools and materials required are readily obtainable.

The dimensions specified are those em-



Dimensions of aluminum, brass and cardboard plates for making a rotary condenser

ployed in making the complete condenser illustrated. Although the fixed plates in this view may appear rather far apart, as a matter of fact they are separated by only 5/64 in., and nearly half of the space between them is taken up by the rotary plates; also it should be noted that the greatest diameter of the condenser casting is but 3¼ in.

In the completed condenser, the fixed and movable plates are separated only 1/40 in. which makes the instrument very compact. The fixed plates are 3 in. in diameter and 1/64 in. thick. The rotary plates are also relatively larger, in proportion to the size of the fixed plates, than is the rule in condensers. The rotary plates are made of thicker material than the stationary ones in order that they may have maximum flatness of surface, and also that they may hold their trueness better. This makes it possible to separate the fixed plates a greater distance, which is desirable for many reasons. In case the experimenter should desire to make the clearance of the plates less than specified, thicker rotary plates should be used. The space between the fixed ones, however, should not be diminished.

The tools required in making the condensers are as follows: one coping or jig-saw, and one hack-saw; one 17/64-in., one ¼-in. and one ⅛-in drill; a small vise, 2 small clamps, a drill stock, and a flat file. These are practically the only tools absolutely necessary; however, certain convenient accessories will be mentioned from time to time in the course of this article.

The materials required are as follows:

Two 3-in. round brass disks, 1/16 in. thick.

One aluminum sheet about No. 22 gage, 12 by 9 in.

One aluminum sheet about No. 26 to 28 gage, 12 by 9 in.

Smooth cardboard or bristol board, 1/40 in. thick, and of sufficient area to make thirty 3-in. disks.

Two pounds of lead.

Two brass machine screws, round or fillister head, about 2 in. long by ¼ in. in diameter, with nuts.

One piece of fiber 2 by 1 in., and 3/16 to ¼ in. thick.

Eight flat head brass machine screws about ⅛ by ¾ in. with 16 nuts to fit.

Two hard rubber or composition typewriter roller knobs with long metal bushings.

Four small binding posts fitted with flat headed brass bolts.

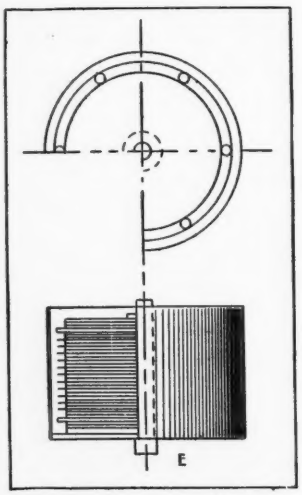
Two old disk records, or ten-cent phonograph records.

One round pasteboard box about 3¼ in. in diameter by about 1½ in. deep.

The first step is to cut the sheet aluminum into 3-in. squares. This can best be done on a tinsmith's cutting machine, or with bench shears, as when cut in this manner the thin metal will not be bent, and none will be wasted in clippings. When this has been done the thin sheets should be cut into 3 in. circles, and the thicker pieces

A into disks 2-11/16 in. in diameter. A tinsmith can do this on a circle cutting machine in a few minutes. Care should be taken not to bend these disks.

The 3-in. aluminum disks *B*, 11 of which can be used, should now be clamped between the two 3-in. brass disks *C*, all edges lying flush, and a 17/64-in. hole drilled through the exact center of the entire pile. If held in a vise care should be taken not to bend the disks by using too much pressure, also if possible the jaws of the vise should be lined up parallel to each other, to prevent uneven pressure.



The types of disks and washers to be placed on machine screw

In case the experimenter desires to make his own disks from the aluminum sheets, it will be found a simple matter to saw out all the 3-in. disks at once, by clamping the squares between the two 3-in. brass plates mentioned, and following the outline of them with a hack-saw. When this has been done all of the disks can be put in shape with a file.

After the center holes have been drilled in the 3-in. disks, and while they are still clamped between the brass disks, 6 holes ⅛ in. in diameter should be drilled as near to the edge of the disks as possible. These can be equally spaced around the circumference.

The smaller aluminum disks are now to be clamped between the 3-in. disks of brass, in such a manner that the centers of all lie in a straight line. While held in this position a 17/64-in. hole should be drilled through these aluminum plates, using the holes in the brass disks as guides.

Now through the entire set of plates just mentioned, four ⅛-in. holes must be made equidistant from each other, with their centers 5/16 in. from the center of the 17/64-in. hole in the middle of these plates as shown at *A*. All burrs around these holes must be removed with a flat file, when the disks are separated.

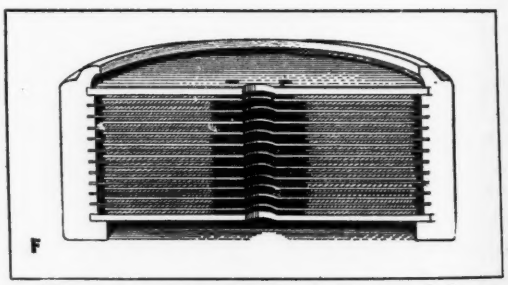
Next, the cardboard sheets, mentioned under the list of materials, should be cut into 3 in. squares and drilled through the center with a 17/64-in. drill as shown at *D*. They should then be clamped between the smaller aluminum disks, say 5 disks on each side, and held together by one of the large machine screws mentioned, which can be passed through the holes in the center of the aluminum and cardboard. By sawing around the outside of the aluminum disks with a hack-saw, all of the cardboard squares can be sawed into disks 2¾ in. in diameter at one time.

As soon as the above steps have been taken, 24 of the cardboard circles should be made into washers by sawing out the centers to form a round hole ¾ in. in diameter. This can be accomplished with a coping saw in a very short time.

When the work mentioned above is completed, the 3-in. aluminum disks *B* should be clamped between most of the cardboard washers, about 10 to a side, in such a manner that the centers of the washers and the disks line up throughout. By starting from the center hole with a coping saw, as in the case of the cardboard washers, the centers of the large aluminum disks can be sawed out to the same extent as the cardboard washers.

If the instructions so far have been adhered to, 4 sets of plates and washers should be the result as illustrated. The 6 cardboard disks with the 17/64-in. holes are not shown in the drawing. All the rough edges and burrs should be removed from all parts with a flat file, due care being taken not to bend the metal pieces.

All of the small aluminum disks when



The appearance of each of the two halves after being cut in two with a hack-saw

completed should be perfectly flat across the surface when tested with a straight edge in several directions. The best and easiest way to straighten the plates which are warped, is to heat each one separately over a blue flame for a few seconds, taking care

not to melt the aluminum. They should then be stamped between a flat piece of marble, such as a table top, wash bowl top, etc., and a hard flat surface 3 or 4 in. square. A blow of from 10 to 15 lb. with an ordinary hammer is sufficient. Two pieces of marble were used by the author to straighten the disks, with excellent results. The large aluminum plates do not need to be straightened unless badly warped.

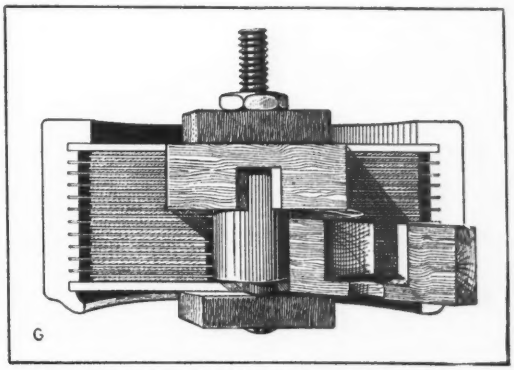
The small piece of fiber, included in the list of parts, can now be sawed into two 1-in. squares, and these drilled through the exact center with the 17/64-in. drill, and then bolted to the 3-in. brass disks, both pieces on one side, so that four ⅛-in. holes can be drilled in the fiber to correspond with those in the brass plates near the center. When this is done these four small holes in the brass disks should be countersunk with the 17/64-in. drill, on one side of each disk.

In the exact center of the bottom of the round pasteboard box, mentioned under "materials," a 17/64-in. hole should be drilled, and one of the large brass machine screws inserted from the outside of the box. An extra heavy pasteboard washer 2¾ in. in diameter with a 17/64-in. hole in the center, should next be slipped over the machine screw and pushed to the bottom of the box, inside. This washer should be about ⅛-in. thick. It should be followed by two or three of the thin cardboard washers which were not sawed out in the center.

One of the brass disks can now be slid down on the brass bolt, the side on which the holes were countersunk facing up. Wire nails with their heads removed should next be placed in each of the four countersunk holes, points up; also two opposite holes near the circumference should have nails so inserted in them.

By placing the various disks and washers over the machine screw, and using the nails in the ⅛-in. holes as guides, a pile of parts should be built up in the following order: 1 brass disk, 2 cardboard washers, 1 small aluminum disk, 1 cardboard washer, 1 large aluminum disk, 1 cardboard washer, 1 small aluminum disk, etc., ending with the other brass disk, placed countersunk side in, and preceded by 2 washers of cardboard, as at *E*.

The four center nails should now be removed, care being taken not to disturb the pile of parts, and the few remaining cardboard washers, with the small center holes, placed on the machine screw, and held down tight while a nut is put on the machine screw, and turned down as hard as possible by hand, and one complete turn with pincers. Too much pressure should be avoided, as it is only desired that the parts should be held in place so as to lie flat against each other, without reducing the thickness of the cardboard through compression. A quarter sectional view of a completed pile is shown at *E*.



The mold of wood which is clamped in place for running molten lead over the movable plates

If all the steps indicated have been properly followed out, there should be a fairly uniform annular space between the pile of disks and the wall of the box. Into this space sufficient melted lead should be poured to cover the complete pile of disks to the top edge of the last piece of cardboard after the 2 nails near the edges of the disks have been removed. The molten metal should be heated in two small pans or ladles for a short time after melting, and all scum and dirt removed from the top. When this has been done two streams of melted lead can be poured in simultaneously, from opposite points near the edge of the round box.

The lead should be run as quickly as possible without spattering. It must be kept going till the necessary amount has been poured.

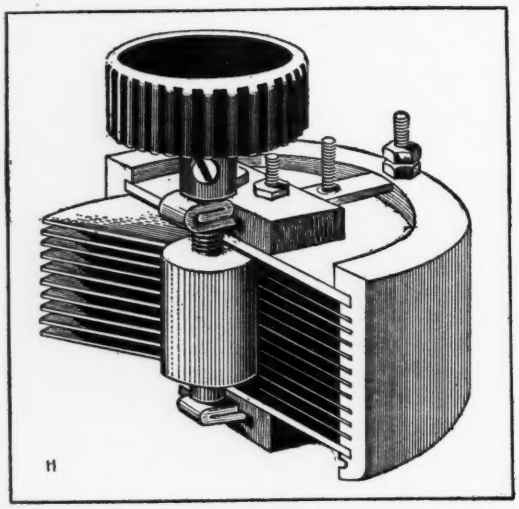
As soon as the lead has cooled the machine screw can be taken out and the complete casting removed from the box. When this has been done the stray pieces of lead can be cut from the top of the pile, so that the cardboard can be removed from the top as well as from the bottom.

The four nails which were removed from the small center holes should now be reinserted and melted paraffin should be poured into the 17/64-in. hole in the center

of the plates, after the bottom of this hole has been stopped up with a short plug.

It will now be found a very simple matter to saw diametrically across, through the entire pile of plates, with a fine-toothed hack-saw. Care should be taken to make the cut run straight through the center of all the disks from the top to the bottom of the pile. The paraffin mentioned acts as a lubricant for the saw and prevents the central portions of the small aluminum plates from being bent. The dividing cut should run midway between the two sets of small holes near the center of the plates.

As soon as the plates have been sawed in half and after the plates have been slightly



Strips of brass used as bearings can be moved in or out and sideways for adjustment

heated to melt out the wax in the middle the nails near the center can be removed. The small spaces between the plates can be cleaned out with an old toothbrush, to remove any small metal shavings which may remain. Each of the two halves should be like the one shown at *F*.

One of the machine screws can now be fitted with the two pieces of fiber mentioned and clamped to one pile of parts, so that the machine screw fits into the semi-circular hole now left in each small aluminum plate.

The two pieces of fiber, which are held against the brass plates by the tightened nut, should be so positioned that the small holes drilled in them line up with the corresponding holes in the brass plates, which should now be filled with putty, and this should be smoothed off flush with the plates on the inside.

A semi-circular mold should be made by boring a $\frac{5}{8}$-in. hole in a strip of soft wood about 1 in. wide by $\frac{5}{8}$-in. thick, to within 1/16 in. of one face of the piece, and then splitting this piece in the direction of the hole through the center. The two halves are then finished by making a cut the full length of each hole, thus forming the wooden mold shown at *G*. In this view one piece is shown in position at the top while the lower piece is tilted back to show its construction more clearly.

When properly clamped in place this mold can be filled with melted lead, which should be poured quickly and run from end to end of the mold while pouring, or poured in a broad stream. The best results are obtained by heating the lead in a heavy ladle from which it may be poured; but in case a thin pan is used, the metal should be heated again for pouring after it has been melted. The illustration shows the lead already poured.

It will now be possible to take away the movable plates from the fixed. Hang the parts between the jaws of a vise after the head of the machine screw has been sawed off, and the pieces of fiber and nut removed, using the machine screw as a support and lightly tapping both ends of the fixed plates simultaneously with a U-shaped metal or wooden bridge and a hammer. Considerable care should be taken not to warp the rotary plates by uneven hammering.

Having separated the plates it will be found a simple matter to remove the cardboard washers, either by shaking them out or picking them out with a pin or needle.

All of the plates should have their edges gone over with a fine nail file to remove any rough spots or burrs caused by sawing. The lead castings on the movable plates should be touched up also. Both ends of these castings should be filed down about 1/64 in. All this should be done with great care.

The two fiber pieces, which are to be used in pouring the center lead supports on both sets of rotary plates, can now be sawed in half, thus making four pieces in all, oblong in shape. These should be split with a saw for a distance of $\frac{3}{4}$-in. from one end, making a 1/16-in. cut, which should run parallel to the largest faces of the fiber. The pieces may next be bolted to the brass plates with the small machine screws, after the putty has been removed from the countersunk holes. The heads of

these machine screws are filed down, so that they can be easily put in place and will rest flush with the surface of the plates.

From a strip of soft brass 1/16 by 5/16 in., two 1-in., and two 2-in. lengths are cut. The ends of these, which should be cut squarely, should now be bent over, the short pieces once, and the long twice, to the extent of ⅜-in., and ¼-in. holes drilled in the center of each little square hill thus formed. Now ⅛-in. holes should be drilled near the flat ends of the long strips, and countersunk on the sides opposite the hills.

A short brass strip should now be slipped on the short end of each rotary plate shaft, and a long strip on each long end, hills facing up as in *H* and *I*. These pieces can be slipped into the channels in the pieces of fiber as shown, and then adjusted by moving them in and out, as well as from side to side, till the rotary plates line up well enough to be swung into position between the fixed plates. The flat headed binding-post bolts can now be inserted in the holes in the ends of the long bearing strips.

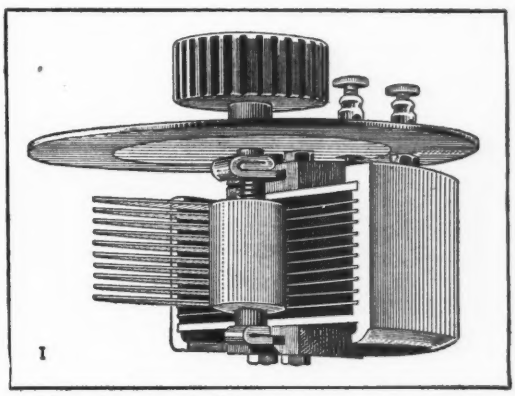
The shafts for the rotary plates should be sawed off so as to extend ½-in. beyond the top bearings, and the metal bushings on the composition knobs drilled with the ¼-in. drill to a depth of ⅝-in., unless they already fit the shafts, as in the case of those bought by the author. Those knobs should now be placed on the shafts and adjusted to such a position that the fixed and movable plates will, when the knob bushings rest on the top bearings, be equally separated from each other, when in the full capacity position.

Now tighten the set screws in the knob bushings and adjust the upper and lower bearings little by little, until the centers of the fixed and rotary plates lie as near as possible in one straight line, without causing any of the plates to touch. When the best adjustment possible has been obtained, the nuts on the small machine screws holding the fiber blocks should be turned up tight, and the ends of the lower sets of screws sawed off flush with the nuts. In case a few plates still touch slightly in one spot or another, they can be bent a little by hand, by pressing with the thumb-nail. All of the plates should swing in one direction without touching. The strip bearings should not come in contact with the fiber-support bolts.

The two phonograph records should now be marked with a compass on the smooth side for 3⅝-in. circles, which can be cut from them by following the lines with a pair of tin-cutters, or, if thick records are to be cut, with a hack-saw. The edges of the small disks formed should be made smooth with sandpaper.

The center holes in these disks can now be enlarged to accommodate the knob bushings, and three ⅛-in. holes can be drilled in each disk to correspond in position with the small machine screws passing through the fiber-bearing supports, and also through the ends of the top bearings. Similar holes should also be drilled ⅜ in. from the edges of the composition tops in line with the center and bearing-end holes.

With the knobs removed, the condenser



Two phonograph disk records are marked with a compass and placed on top of the condenser

tops are now temporarily fitted to the condensers. Using the holes nearest the edges as guides, drill ⅛-in. holes in the lead castings till the brass plates are struck. The bottom screws from a set of binding posts should now have their heads removed, and be screwed into these holes in the lead, making their own thread. They should then be fitted with a pile of small brass washers, equal in height to the top part of the nuts on the bolts passing through the fiber.

To complete the condenser units the tops should now be fastened on, smooth sides up, and held in place by nuts on the two center bolts on each unit and on the two binding posts, as shown at *I*. The composition knobs can now be properly placed on the shafts and held in position by tightening the set screws in the bushings.

Suitable scales, pointers and stops can be supplied to please the fancy of the individual. The instruments are then ready to be mounted in the most convenient manner.

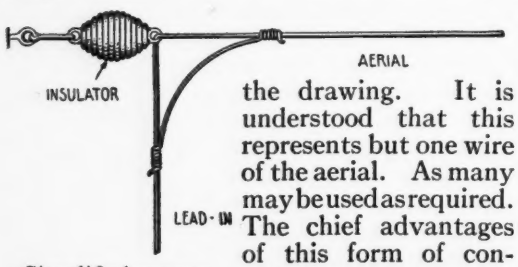
An excellent oil-tight case can be made at small cost from an aluminum cup about 3½ in. in diameter. Glass cases can be made from large paste pots, oil-cup glasses, etc., or if desired complete composition cases can be purchased ready made. When mounted in any cabinet set the appearance of the instruments in question can be made to equal that of any condensers made. The maximum capacity of the condensers described is approximately .008 microfarad.

If these instructions are carefully followed, the results will be very gratifying. There are many minor points brought out in the description which represent several months' experimentation on the part of the author. Although slight variations of construction may appear feasible, it should be borne in mind that such deviations should be attempted only with the idea of experimentation. In order to do anything right the first time, it must be done according to rule. Experimentation often means destruction instead of construction.

The total cost for materials used in making two condensers by the above method should not exceed $1.50 exclusive of cases. The time required may vary from 6 to 20 or more hours. Tests should be made for short circuits with head-phones and a battery.

An Improved Method of Aerial Construction

THE construction of an aerial is greatly simplified if the wires are cut equal to the length of the aerial proper, plus the length of the lead-in, and connected as in the drawing. It is understood that this represents but one wire of the aerial. As many may be used as required. The chief advantages of this form of construction are that it requires no soldered joints, since the wire is in one piece from the lightning switch to the top of the aerial; that it has no sharp corners to start brush discharges, and that the lead-in has very nearly the same current carrying capacity as the aerial, since it is made up of exactly the same number of wires.—EDWARD L. NORTON.



Simplified connection for an aerial wire and the lead-in

Some Useful Hints for the Radio Operator

IF your tuner is wound with bare wire on a threaded core, and the wire has worked loose, put it in the refrigerator over night so that the chill will contract the tube. Immediately upon removing it, work the wire tight with the hands and fasten. As the tube warms to the temperature of the atmosphere it will expand, thus drawing the wire tighter than could be done with a machine.

Wipe off the tuner switch contacts with a piece of silk and rub the blade back and forth over some 0000 French emery paper about once a week. This will keep the blade from wearing rough, and the switches will always work without scraping.

Silk is one of the best materials for keeping the surfaces of rubber and nickel parts bright.

Rub old and discolored hard rubber panels briskly with some cheesecloth saturated in household ammonia, and finish with a piece of silk dipped in crude oil, to restore to the surfaces their former black color and polish.

Use a battery-switch instead of a button on your buzzer test circuit. This will enable you to use both hands in adjusting the detector.

If your cabinets are all finished with wax or oil instead of varnish, they will not show dust, finger marks, smears, etc. Dull nickel plate holds the same advantage over the polished kind.

A relay can be employed to advantage by connecting the magnets with an arm on the antenna switch and using the contacts for short circuiting the detector while sending. With the relay in circuit, throwing over the aerial switch may perform five operations, namely: It may disconnect the receiving set from the aerial, short circuit the detector, connect aerial to oscillation transformer, connect power to transformer primary, and start the rotary gap motor.

A pair of amber, smoked or blue glasses will protect the operator's eyes from the strain and burning sometimes caused by the spark.

If you desire to get efficiency on a 200-meter wave, which means that the closed circuit connections must be as short as possible, mount your condenser and transformer together in the same case, and arrange your gap on top of them. Fill the case with oil.—EDWIN L. POWELL.

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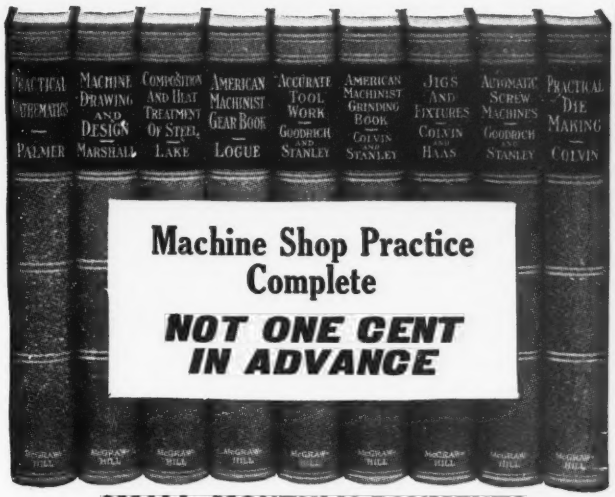
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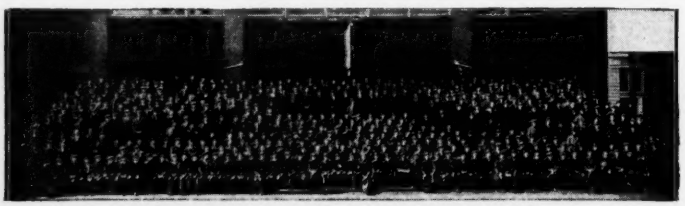

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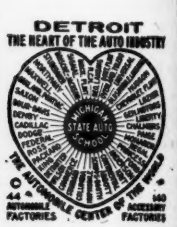

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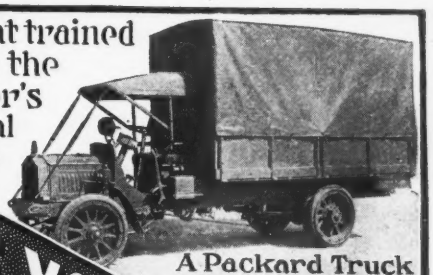

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Aerial View of Motor Truck Group at Ft. Sam Houston, Texas
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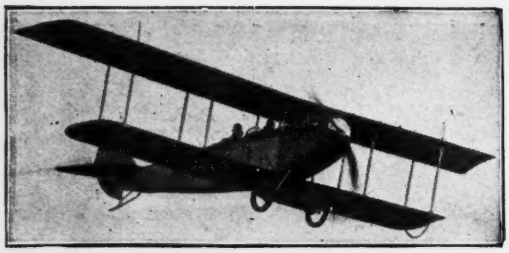

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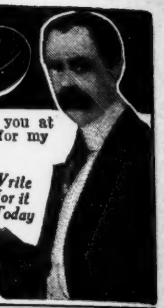

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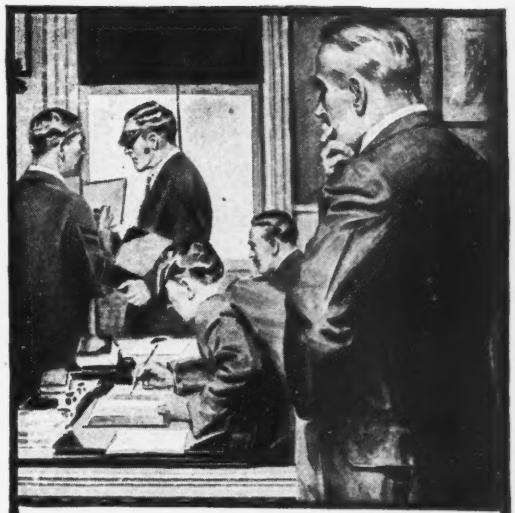

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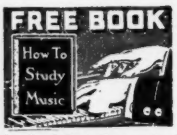

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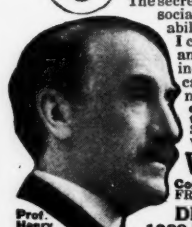

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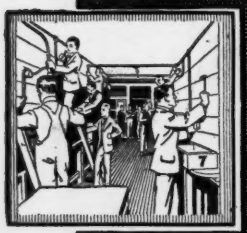

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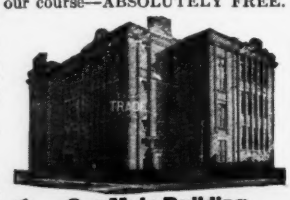

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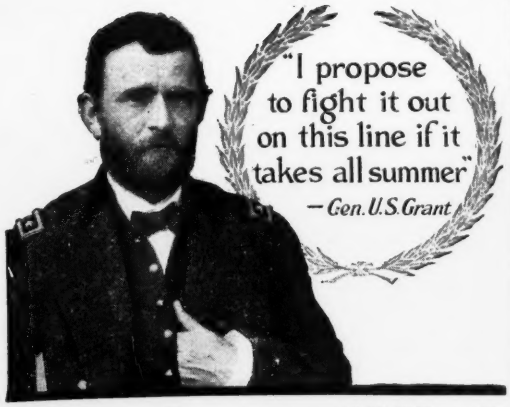

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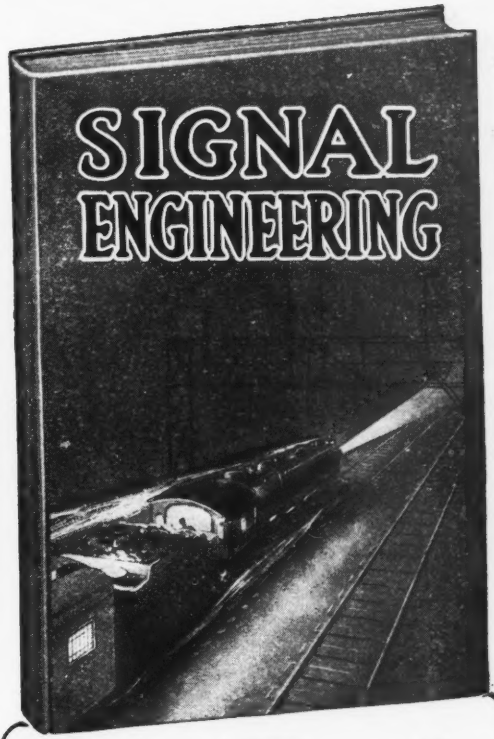

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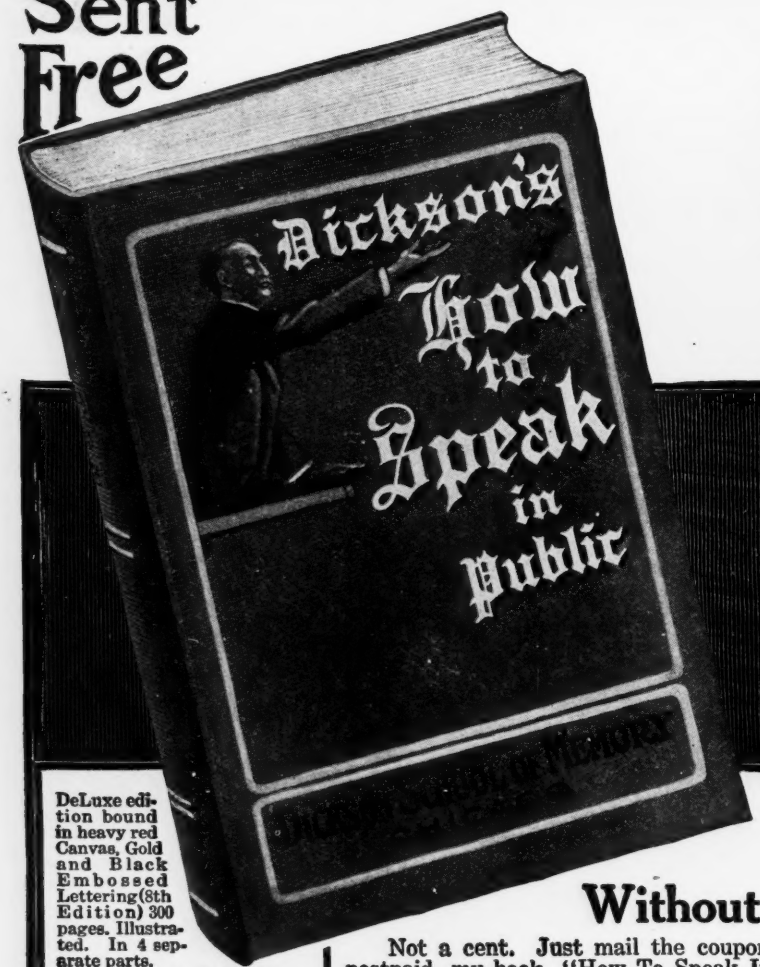

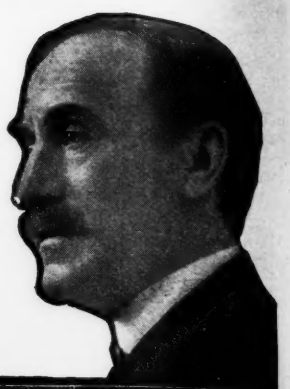

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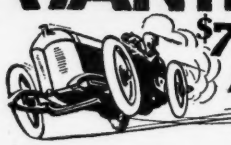

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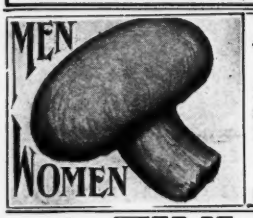

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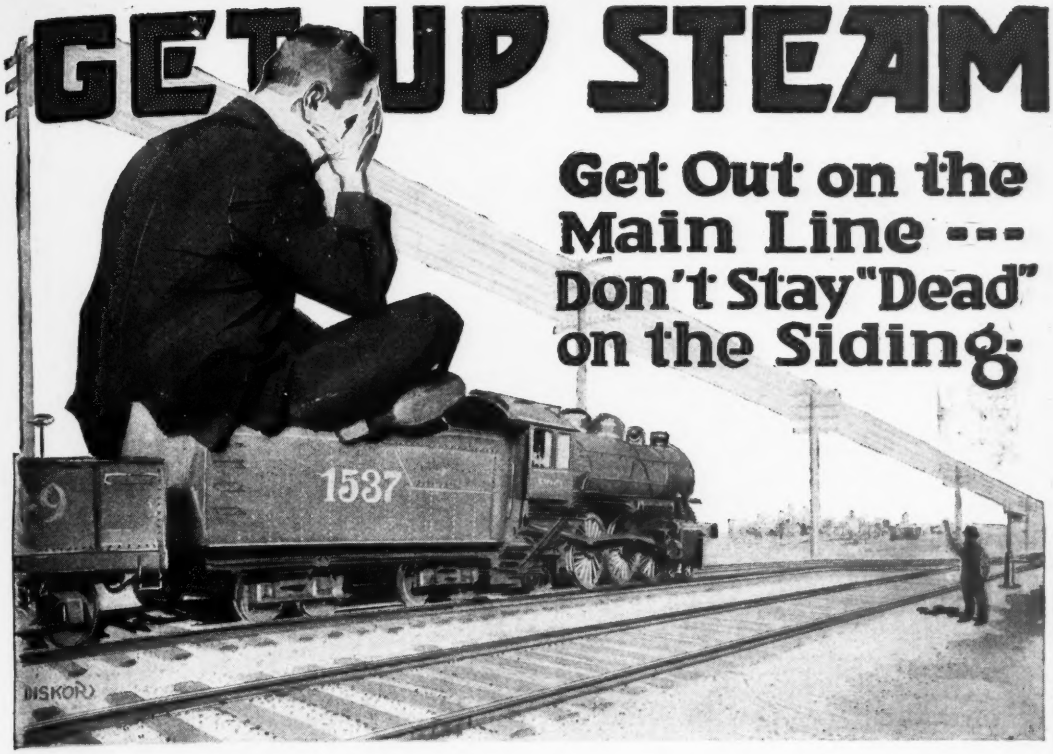

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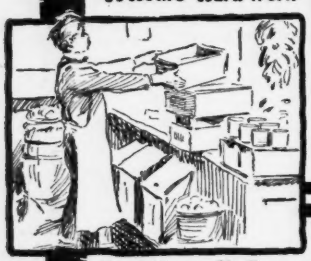

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Allentown—H. Leh & Co.
Altoona—Bartle's Stationery Store, 1327 11th Ave.
Bradford—Barney Garbarsky
Butler—Eyth's Book Store, 103 So. Main St.
Chester—Spencer Stationery Co., 523 Market St.
Connellsville—Penn Office Supply Co., 113 W. Crawford Ave.
Erie—Trask, Prescott & Richardson Co., State at 9th St.
Greensburg—A. E. Troutman Co.
Harrisburg—Dives, Pomeroy & Stewart
Lancaster—The Donovan Company
McKeesport—J. D. O'Neil Co.
New Castle—New Castle Dry Goods Co.
Norristown—Warner's Dept. Store
Oil City—W. K. George, 224 Seneca Street
Philadelphia—Gimbel Brothers, 9th & Market Sts.
Pittsburgh—Joseph Horne Co., Penn & 5th Ave.
Pottstown—Chas. J. Custer, 206 High St.
Scranton—Hagen & Wagner Co., 205-7 Washington Ave.
Shamokin—Bee Hive Dept. Store
West Chester—Fath's, 22 No. High St.
Williamsport—Horace Y. Otto, Market Square Book Store
York—Barnhart's Book Store, 35 W. Market St.

Rhode Island

Newport—Carr's, Daily News Bldg.
Pawtucket—A. A. Lupien, 24 Broad St.
Providence—The Boston Store, 239 Westminster St.
Woonsocket—Harris & Mowry's

South Carolina

Charleston—Louis Cohen & Co.
Columbia—The State Book Store, State Bldg.

South Dakota

Aberdeen — The Salisbury Book Store, Cor. Main St. & 3rd Ave.
Sioux Falls—The Cataract Book & Stationery Co.

Tennessee

Memphis—Bry-Block Mercantile Co., Main St. & Jefferson Ave.
Nashville — Presbyterian Book Store, 415 Church St.

Texas

Austin—Jno. E. Keller, 716 Congress Ave.
Beaumont—E. Szafir & Son Co.
Dallas—Hargreaves Printing Co., 1012 Elm St.
El Paso—Popular Dry Goods Co., Inc.
Fort Worth—The Fair
Galveston—Ohlendorf's Book Store, 2015 Market St.
Houston—Teolin Pillot Co., 409 Main St.
Waco—Goldstein-Migel Co.

Utah

Ogden—Bramwell Book & Stationery Store, 2362 Washington Ave.
Salt Lake City—Sunday School Union Book Store, 44 East on South Temple

Vermont

Burlington—The W. G. Reynolds Co.
Rutland—The Tuttle Co., 11 & 13 Center St.

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Lynchburg—J. P. Bell Co., Inc., 816 Main St.
Norfolk—William Freeman, 304 Main St.
Petersburg—T. S. Beckwith & Co.

Washington

Aberdeen—Benson Office Supply Co., Wishkah & H Street
Bellingham—E. T. Mathes Book Co., 110 W. Holly St.
Everett—The Grand Leader Dry Goods Co.
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Tacoma—Cole-Martin Co., 926 Pacific Ave.
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Charleston—The S. Spencer Moore Co., 118 Capital St.
Huntington—Zenner - Bradshaw Co.
Wheeling—Stone & Thomas

Wisconsin

Beloit—Cleveland's, On the Bridge
Eau Claire—Eau Claire Book & Stationery Co.
Fond du Lac—J. W. Burnton Book Store
Green Bay—Eckhart Bros., 223 N. Washington St.
Janesville—Jas. Sutherland & Sons, 12 S. Main St.
Kenosha—C. H. Ernst & Co., 271 Main St.
Madison—University Co-operative Co., 504-508 State St.
Marinette—Krueger's Drug Store, 1904 Hall Ave.
Milwaukee—Gimbel Brothers, Grand Ave., S. E. corner W. Water St.
Oshkosh—Hurn's Book Store, 147 Main Street
Racine—S. H. White, 504 Monument Square
Wausau—Winkelman's Dept. Store

✦ ✦ ✦

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Calgary, Alta.—Young & Kennedy, Ltd., 715 First St., West
Edmonton, Alta.—A. H. Esch & Co., Ltd., Jasper Ave. at 104th St.
Fort William, Ont.—Walker's 417-419 Victoria Ave.
Halifax, N. S.—Nova Scotia Furnishing Co., Ltd., 72-76 Barrington St.
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Kingston, Ont.—The College Book Store, 160-162 Princess St.
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Moose Jaw, Sask.—Robinson, McBean, Ltd.
New Westminster, B. C.—New Westminster & Fraser Valley Dept. Store
Ottawa, Ont.—James Hope & Sons, Ltd., 61-63 Sparks St.
Peterboro, Ont.—Trebilcock Bros., 417 George St.
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If Our Stomachs Only Had Windows!

By R. W. LOCKWOOD

EUGENE CHRISTIAN

If our stomachs only had windows so that we could see and realize what happens in the struggle to digest some of the combinations of food we swallow, it is likely that our habits of eating would be revolutionized overnight.

I believe that fully 90% of all sickness is caused by the inability of our digestive organs to cope with the food we ask them to assimilate. So ill-chosen are our daily foods that we not only fail many times to benefit by their brain and body-building elements, but are also unable to properly and regularly eliminate the waste.

The dangerous body poisons which are formed as a consequence seep into the blood and gradually lower our efficiency, sap our vitality, and rush a great many of us to an early death. Eugene Christian, the noted food specialist, says the fact that the average American dies at 43 is due more to wrong food combinations than to any other cause. Acidity, fermentation and constipation are merely symptoms of serious ills that must naturally follow unless the *cause* is eliminated.

This question of proper food combinations is the most important in the field of eating. Very often one food of great value in itself, when eaten in combination with another equally good food, produces a chemical reaction in the stomach, and literally explodes. Is it any wonder then that so few of us are more than 50% efficient in our daily lives, that we accomplish just about one-half the tasks which we set out to do, and see so many of our fine ambitions crumble to dust?

But just as wrong food combinations cause sickness, so do right combinations prevent and correct it by removing the cause. If we will give Nature half a chance, she will do her share towards producing the results for which we are striving, as Eugene Christian is proving for hundreds of people to-day—and as he proved in his own case.

Twenty years ago Eugene Christian was at death's door; for several years previous he had suffered all the agonies of acute stomach and intestinal troubles, until his doctors—among them some of the most noted specialists in the country—gave him up to die. As a last resort, he commenced to study the food question himself. As a result of what he learned, he succeeded in literally *eating his way back to health* without drugs or medicines of any kind, and in a remarkably short space of time.

Eugene Christian is to-day nearly sixty years old—or shall I say young? For he has more vitality, more ginger, more physical endurance than most youngsters in their teens. For almost fifteen years he has not had even so much as a cold.

To-day Eugene Christian is teaching hundreds of other men and women how to eat their way to buoyant health and increased energy by properly combining and proportioning their every-day foods, and entirely without the use of medicine. An interesting feature of Christian's work is the fact that you can secure the foods he recommends at any store or out of any garden. No special or patented foods are required.

I have been told that a number of wealthy people who have gone to him after everything else had failed have been so happy at their complete restoration to health through his simple suggestions that they have voluntarily sent him checks for from $500 to $1,000 in addition to his regular charge.

So much interest has been displayed throughout the country in the results of corrective eating that Eugene Christian has written a set of 24 Little Lessons for the use of the thousands of people unable to call at his office.

These Little Lessons, which are sent for examination to any one on request, contain the boiled down experience of Eugene Christian's twenty years' study of foods and their relation to health and efficiency, and give actual menus covering every condition of health and sickness, for every age and for all seasons, climates, and occupations.

The letters received by Eugene Christian from users of these lessons telling their experiences with Corrective Eating are as startling as they are full of interest.

Just the other day he received a letter from Mr. I. J. Ayres, head of an insurance agency in Hutchins, Texas, who wrote: "My health began to fail about one year ago. Up to this time I had enjoyed reasonably good health all my life—am 58 years old. I had, however, been troubled with constipation nearly all my life. My health grew worse and I lost in weight from 140 to 120 pounds. When I began using the Little Lessons I began to improve from the first, and now for months I have felt better than I have for years past, and am completely cured of constipation. My restoration to health is due to the Little Lessons in Scientific Eating."

Another letter of interest just received is from a prominent Manchester, New Hampshire, man. He writes: "At the time I sent for the Little Lessons I was troubled with a very bad acid stomach, fermentation, etc. My stomach pained me as badly as any ulcerated tooth. After receiving them (the lessons) I followed directions and in about ten days the pain grew less. In two weeks I was free from pain. Gradually I grew stronger, also gaining weight. Weight was 112—now 130. Last June it was an effort for me to walk one mile. Since last November I have been in the woods almost daily hunting and walking from four to fifteen miles per day." And he says "the lessons did it."

Another interesting letter is from the head of a manufacturing concern in Fillmore, New York, who writes: "I was troubled with fermentation and constipation, had to take something every day to move my bowels, my weight was normal but I had no strength. I followed your directions and am much better. Do not take any laxatives—bowels move every day and am much stronger."

These are only a few, but they are typical of letters that come almost every day from users of the Little Lessons, and the message is always the same. As one woman writes: "Corrective Eating has relieved me of much suffering—in fact, I think it has saved my life, for which I am so grateful." And then she tells the whole story of how after everything else had failed and she was growing worse each day the Little Lessons showed her the way to health and strength.

Truly these lessons are doing a remarkable work in putting Eugene Christian's scientific knowledge of food in the hands of so many thousands of sufferers throughout the country.

With these lessons at hand it is just as though you were in personal contact with this great food specialist, because every point is so thoroughly covered and so clearly explained that you can scarcely think of a question which isn't answered. You can start eating the very things that will help to produce the increased physical and mental energy which you are seeking the day you receive the lessons. And you are quite likely to feel some results after your very first balanced meal.

If you would like to examine the 24 Little Lessons in Corrective Eating, simply write the Corrective Eating Society, Inc., Dept. 66, 450 Fourth Avenue, New York City. It is not necessary to enclose any money with your request. Merely ask to have the lessons mailed for five days' trial with the understanding that you will either send the small price asked, $3, or remail the books. Merely clip out and mail the following form instead of writing a letter, as this is a copy of the official blank adopted by the Society and will be honored at once.

CORRECTIVE EATING SOCIETY, Inc.
Dept. 66, 450 Fourth Avenue, New York City

You may mail me the "Lessons in Corrective Eating" for examination. Five days after I receive them I will either send you $3 (full payment) or remail them to you.

Name..... **Address**.....

How I Have Made Poor Men Rich

What I Have Done to Increase Men's Earnings by Hundreds of Thousands of Dollars

By P. O. W.

IT HAS been my privilege to have made several men rich. Men who had been kicked and cuffed around by fate came to me almost without a dollar and are to-day in position to purchase all the good things of life. Old men have come to me when the world had classed them among life's tragedies and I have helped put them on their feet—so they can now enjoy their remaining years in comfort. Young men just out of their teens—clerks, bookkeepers, laborers, who felt that they were unlucky—that they had no future—that they would be plodders all their lives—have come to me with their troubles and I have taken great pleasure in being of service to them.

I am anxious to be of help to others—I believe it is really my duty to humanity that I make mention of the methods through which I have accomplished so much.

Every millionaire has his own pet secret of achievement. Thomas A. Edison maintains that success is made up of two per cent inspiration and ninety-eight per cent perspiration. Andrew Carnegie has said that success in life depends upon forming the habit of thrift—saving money. Others tell us to prepare for the job ahead. And so it goes—every big man has his own particular formula for success. Mine, however, is different from any that I have ever heard of. Yet, it is so simple that anyone can put it into practice almost at once and the results, as I shall show later, are almost miraculous.

In formulating my recipe for success I have taken into consideration what I learned from the thousands of men who have come to me. I believe I know what holds most men back. I believe I know what produces winners in the race for success. I am not propounding theories—instead, I am stating actual, indisputable facts based upon real-life experiences.

The one outstanding conclusion I have come to is that practically every living man has within himself every money-making quality—save one. I have found that most men have ideas—money-making ideas which they cannot at once use, but which they are planning to use "when the right time comes." I have found that most men are ambitious—eager and anxious to get ahead. And I have found that most men are gifted with brains enough to make good when the right chance presents itself. Why is it then, that though we all possess practically every success quality, not more than one in ten thousand succeeds in a big way? The answer is simple. Most men are afraid—of themselves, of others, of things. They have brilliant ideas but they haven't the force of will to put them over. If they need money to go into business for

themselves, they are easily beaten in their efforts to get it. If they want more pay, they wait patiently for a little increase. If they have an important decision to make, they flounder around on the sea of uncertainty. *They are fighting for success without the help of man's greatest asset—a strong, inflexible, indomitable will.*

Let me cite a few instances to show what a strong will has meant to others:

William F. Kay of San Francisco was out of a job, had, in fact, been out of work for some time. I came to him on the 13th of February when he was as deeply imbedded in gloom as he had ever been in his life. He was discouraged, disheartened, sick at heart. In a few moments' talk, however, I showed him how to focus his energies instead of scattering them. Three days later he secured a position which he says he certainly wouldn't have even applied for previous to our conversation. He feels that the methods he used in securing his position can be applied in securing practically anything else he desires!

Allen H. Vance of Delanco, N. J., says that the hints I gave him will gain him a position paying him $5,000 a year, whereas now he is only getting $1,000. Mr. C. Struble of Sandusky, Ohio, closed a $2000 deal shortly after I came to him. J. H. Lane of Richmond, Va., a life insurance agent, immediately went out and earned $300 after my visit with him. A famous efficiency engineer—a nationally known figure—says that he would not take $3000 for the information I gave him. He adds that a young man to whom he recommended me has increased his earnings just about 800% during the past year.

Mr. H. D. Ferguson of Hot Springs, Ark., increased his earnings from $40 to $90 a week in a remarkably short space of time after he began the study of the suggestions I gave him. But the most remarkable case of all is that of a young man who, three years ago was earning $30 a week, and who now is worth $200,000 and increasing his fortune at the rate of $1000 a week. He attributes his success to my help.

Perhaps you will wonder who I am. It will surprise you to know that I am not an individual—but a book—"Power of Will." I was written by Professor Frank Channing Haddock, a scientist whose name ranks with those of James, Bergson and Royce. Professor Haddock proved that will power can be developed just as easily as the muscles of the arm—by intelligent exercise, and he was able to set down the very methods by which anyone can develop the will, making it a bigger, stronger force each day.

My publishers will gladly lend me to anyone for five days. It is not necessary to send any money in advance. Let me come into your home—let me talk to you as I have spoken to so many thousands of others. Then, if you are satisfied with what I tell you, send only $3 to the publisher. If not, merely send me back and you will owe nothing. When you receive me for examination, let me tell you about the law of great thinking—let me show you how to develop analytical power—how to perfectly concentrate on any subject—how to guard against errors in thought—how to drive from the mind unwelcome thoughts—how to develop fearlessness—how to use the mind in sickness—how to acquire a dominating personality.

I am only a book, so a few doubters may scoff at the idea of my being able to help them. But the great mass of intelligent men and women will at least investigate for themselves by sending for me on approval. Over 200,000 people have read me and have praised me to the skies. Men like Supreme Court Justice Parker, Wu Ting Fang, ex-U. S. Chinese Ambassador; Lieut.-Governor McKelvie of Nebraska, Asst. Postmaster-General Britt, General Manager Christeson of Wells Fargo Express Co., E. St. Elmo Lewis, Governor Arthur Capper of Kansas, and thousands of others, equally prominent, have read me and have said that I am the book every young man and every old man, who wants to succeed, should have.

As a first step in will training, mail the coupon below, NOW—addressing it to the Pelton Publishing Company, 14-K Wilcox Block, Meriden, Conn., or just copy it on a postal card, or a letter.

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I will examine a copy of "Power of Will" at your risk. I agree to remit $3 or remail the book in 5 days.

Name.....

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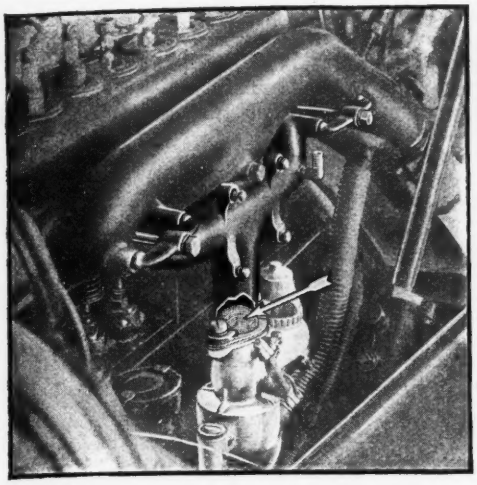

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You know that one-third of the low grade fuel in common use does not vaporize easily and goes to the engine as globules of raw gasoline, which simply burns, forms carbon deposits and reduces the working efficiency of the engine.

This condition prevents you from making the big hills, from starting easily and quickly, and from getting the maximum power from your car.

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By spreading the fuel into a very thin vapor-spray, the Eclipse Vaporizer gives more rapid and complete vaporization and greater homogeneity of the final mixture. The air and gasoline are thoroughly mixed, thereby giving a perfectly combustible charge for the engine. This gives increased power and economizes on fuel.

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You can take the heavy grades with greater ease, hold your own against the motorist who attempts to pass you on the road and maintain a smoother, quieter motor, that can be slowed down on high gear to three miles an hour without bucking.

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The Eclipse Vaporizer is extremely simple, **no boring necessary; no mutilation of car;** out of sight all the time; never needs attention; lasts forever. Nothing to get out of order, nothing complicated, just a special patented copper cone, which can be installed on any engine in a jiffy. But what a difference it does make in the operation of the car! What a saving of expense! What a help to efficiency! And there is positively no danger of back-fire! The Eclipse Vaporizer will enhance every merit the motor possesses. It is a necessary auxiliary to the complete efficiency of every gasoline carburetor.

And not alone is its use confined to the pleasure car—it is a device equally as important to the efficient working of gasoline power engines of contractors, builders and farmers; to motor boats and motor trucks.

Think what 25 per cent more power would mean to your motor truck's hauling ability; to the speed of your motor boat and to the big saving on a contracting job!

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We want you to know from your own experience just what a remarkable aid the Eclipse Vaporizer is; to actually test it under your own peculiar conditions; to put your Eclipse Vaporizer equipped car against the steepest hills and on the fastest stretch of road you know of, and in that manner thoroughly test it for gasoline consumption, increased power and speed. Keep your eye on the speedometer the while!

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Everywhere—from the Atlantic to the Pacific—thousands and thousands of gasoline motors are equipped with this amazing device, and every buyer of one invariably recommends others to buy one; and so all over the land enormous quantities of gasoline are being saved and increased efficiency is being given to motors.

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Tear out the coupon right now, enclose $3.50 with the distinct understanding that if the Eclipse Vaporizer does not give the results we claim for it that you will get your money back on request. Remember, your $3.50 is only DEPOSITED with us and is returnable on demand. Send us the coupon and remittance N-O-W.

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The Eclipse Vaporizer is positively the fastest-selling automobile accessory on the market today. Sells more easily than anything of its kind ever introduced. Dealers everywhere are putting them in. Remember, it is attached in a jiffy, with no other tool than a wrench—**no boring necessary, no mutilation of car.** Wrte for dealer proposition at once.

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Eclipse Free Engine Clutches for Motorcycles
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Morrow Bicycle Coaster Brake

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Dept. A. Elmira, N. Y.

Enclosed find $3.50 in full payment for one Eclipse Vaporizer—with the distinct understanding that you guarantee it to save 25 per cent in gasoline and add 25 per cent power to my motor, and refund my deposit of $3.50 if I return your device within 60 days.

I use a .....sized carburetor
Name of car.....
Model.....Year.....
Name.....
Address.....
I recommend as a live dealer.....
.....of.....

OIL BANKING

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If you are a veteran you know this: An oil that burns up rapidly or breaks down quickly cannot be really cheap. Though it may be low-priced by the gallon, it is bound to prove high-priced by the mile.

You know that a wrong-bodied oil raises your gas consumption. Instead of saving your oil pennies it eats up your gas dollars.

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Because the experienced motorcyclist of today knows that the higher price per gallon of Gargoyle Mobiloils means a lower cost per mile in operating expense.

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Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
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In the Chart below, the letter opposite the motorcycle indicates the grade of Gargoyle Mobiloils that should be used. For example, "A" means Gargoyle Mobiloil "A," "Arc" means Gargoyle Mobiloil "Arctic," etc. For all motorcycle transmissions use Gargoyle Mobiloil "C." The recommendations cover all models of the same make, unless otherwise noted.

MODEL OF	1917		1916		1915		1914		1913	
MOTORCYCLES	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
A. M. C.	...	...	B	A	B	A	B	A	B	A
American	...	...	...	...	...	...	B	A	B	A
Amer. Peugeot (2 cyl.)	...	...	...	...	...	...	B	A	B	A
" " (4 cyl.)	...	...	...	...	...	...	...	...	A	Arc.
Arrow	...	...	...	...	...	...	...	...	B	A
Autoped	B	B	B	A	...	...	...	...	...	...
Auto Tri	...	...	...	...	...	...	...	...	B	A
Bailey Flyer	...	...	...	...	...	...	B	A	B	A
Black Hawk	...	...	...	...	...	...	...	...	B	A
Cleveland	B	B	B	B	...	...	...	...	...	...
Crawford	...	...	...	...	...	...	B	A	...	...
Curtiss	...	...	...	...	...	...	B	A	B	A
Cyclemotor	B	B	B	B	...	...	...	...	...	...
Cyclone	...	...	...	...	B	A	...	...	...	...
Dayton	B	A	B	A	B	A	B	A	B	A
De Luxe (1 cyl.)	...	...	B	A	B	A	B	A	B	A
" " (2 cyl.)	...	...	B	A	B	A	B	A	A	Arc.
Eagle	...	...	B	A	B	A	B	A	A	A
Emblem (1 cyl.)	...	...	B	A	B	A	...	...	B	B
" (2 cyl.)	B	A	B	A	B	A	B	A	B	A
Excelsior	A	A	A	A	A	A	B	A	B	A
" (Lightweight)	B	B	B	B	...	...	...	...	...	...
Feilbach	...	...	...	...	...	...	...	...	A	Arc.
Flanders	...	...	...	...	B	A	B	A	B	A
F. N.	...	...	...	...	...	...	...	...	A	Arc.
Geer	...	...	...	...	...	...	...	...	B	A
Greyhound	...	...	...	...	...	...	...	...	B	A
Harley-Davidson	B	A	B	A	A	Arc.	A	Arc.	A	Arc.
Henderson	A	A	A	A	A	Arc.	A	Arc.	A	Arc.
Indian (1 cyl.)	...	...	B	B	B	A	B	A	B	B
" (2 cyl.)	B	A	B	A	B	A	B	A	B	A
Iver Johnson	B	A	B	A	B	A	B	A	B	A
Jefferson	...	...	...	...	...	...	B	A	B	A
Limited	...	...	...	...	...	...	A	Arc.	...	...
Majestic	...	...	...	...	...	...	...	...	B	A
Marvel	...	...	...	...	...	...	...	...	B	B
Maxim Tricar	...	...	...	...	...	...	B	A	...	...
Merkel	B	A	B	A	B	A	B	A	B	A
Miami (Power Bicycle)	B	A	B	A	...	...	...	...	...	...
Michaelson	...	...	...	...	B	A	B	A	B	A
Militaire	...	...	A	A	...	...	...	...	...	...
Minneapolis	...	...	...	...	...	...	...	...	B	A
M. M.	...	...	...	...	...	...	...	...	B	A
Monarch	...	...	...	...	B	A	B	A	B	A
Motorette	...	...	...	...	E	E	E	E	E	E
New Era	...	...	...	...	...	...	...	...	B	A
New Hudson	...	...	...	...	...	...	...	...	B	B
N. S. U. (1 cyl.)	...	...	...	...	...	...	...	...	B	B
" " " (2 cyl.)	...	...	...	...	...	...	...	...	A	Arc.
Okay	B	B	...	...	...	...	...	...	...	...
P. E. M.	...	...	...	...	...	...	...	...	B	A
Peugeot	...	...	...	...	...	...	...	...	B	A
Pierce (1 cyl.)	...	...	...	...	...	...	B	A	B	A
" (4 cyl.)	...	...	...	...	...	...	A	Arc.	A	Arc.
Pirate	...	...	...	...	...	...	B	A	B	B
Pope	B	A	B	A	B	A	B	A	B	A
Reading Standard	B	A	B	A	B	A	B	A	B	A
Reliance	...	...	...	...	...	...	...	...	B	A
Schickel	B	A	B	A	B	A	B	B	A	Arc.
Scout	...	...	...	...	...	...	...	...	B	B
Shaw	...	...	B	A	B	A	B	A	B	A
Smith (Motor Wheel)	A	A	A	A	A	A	...	...	...	...
Theim	...	...	...	...	...	...	B	A	B	A
Thor (1 cyl.)	B	A	B	A	B	A	B	A	B	B
" (2 cyl.)	B	A	B	A	B	A	B	A	B	A
Tiger Autobike	...	...	B	B	...	...	...	...	...	...
Wagner	...	...	B	A	B	A	B	A	B	A
Yale (1 cyl.)	...	...	...	...	B	A	B	A	B	B
" (2 cyl.)	...	...	...	...	B	A	B	A	B	A

$7.50 MAKES YOUR

$7.50 is the Price of a Set of 12 *American Hammered Piston Rings*

Install a set of these rings in your car and these are the results we guarantee:—

10% to 30% more power on
25% to 50% less gasoline and
50% to 75% less oil consumption

No more Carbon. No more Spark Plug Trouble. No more Smoking. Prevent cylinders from getting out of true and save the cost of reboring.

American Hammered Piston Rings add new force, new vitality to a Ford Motor because the permanent tension of these rings has been obtained through a **Hammering Process** with **Ball Pointed Hammers.** The only process in existence which will absolutely guarantee the **Original** strength and tension of the piston ring during the **Life** of the **Motor.** Thus ensuring **Economical Performance Always.**

THEY'RE A NECESSITY
NOT A LUXURY

American HAMMERED Piston Rings They're LEAK TIGHT

WARNING!

American Hammered Piston Rings are made of **One Piece.** Do not use Piston Rings of more than one piece. If you want to know why write us and we'll be glad to tell you the reason. If you have trouble with your engine **Write Us** before you install any other piston rings. We can help you and give you some valuable advice. We will help you get greater service at less cost and the maximum of pleasure from your car.

FORD
A HIGH POWERED CAR

BE SURE TO USE
AMERICAN HAMMERED PISTON RINGS

What We Prove

AMERICAN HAMMERED PISTON RINGS are simple in construction and positive in performance. They are easy to install. They will increase the power of any motor from 10% to 30% on 25% to 50% less gasoline and 50% to 75% less oil. There will be no carbon deposit, no more spark plug trouble and your cylinders cannot possibly get out of true. Your motor will run smoother, and quieter, and take hills on high that you were unable to negotiate before you installed these rings. These are strong claims—but we prove them to your entire satisfaction or we refund the purchase price. You have ONE WHOLE YEAR IN which to satisfy yourself.

Here's the Proof

The proof of these WONDER RINGS is best demonstrated by ACTUAL USE. Our claims are established when we say that every Pierce-Arrow, Chalmers, Winton, Mercer, Stearns, Lozier, International, White, Kelly-Springfield, and other makes of automobiles and motor-trucks ARE EQUIPPED WITH AMERICAN HAMMERED PISTON RINGS. These rings are STANDARD EQUIPMENT. And for these automobile manufacturers there is no BETTER PISTON ON THE MARKET.

Used exclusively by Pierce-Arrow, Chalmers, Winton, Mercer, Stearns, White, Lozier, International, Kelly-Springfield, Stegeman.

Money Back Guarantee

Buy a set of AMERICAN HAMMERED PISTON RINGS for your Ford from your garage or accessory Dealer. If they can't supply you send us $7.50 in check or money order and we will mail you a set. If desired set will be sent C. O. D. If, within one year after installing these rings in your car you are not satisfied with results, send rings back to us and your money will be refunded. This guarantee applies to all AMERICAN HAMMERED PISTON RINGS—no matter what make car you buy them for.

You Need These Rings on Your Ford

Any Piston Ring that is used on such cars and trucks as Pierce-Arrow, Chalmers, Winton, Stearns, Lozier, Mercer, White, Kelly-Springfield, International and which is guaranteed absolutely to give your FORD motor 10% to 30% more power on 25% to 50% less gasoline and 50% to 75% less oil is sure to save you money. INSTALL THESE RINGS immediately and get more service at less cost from your FORD.

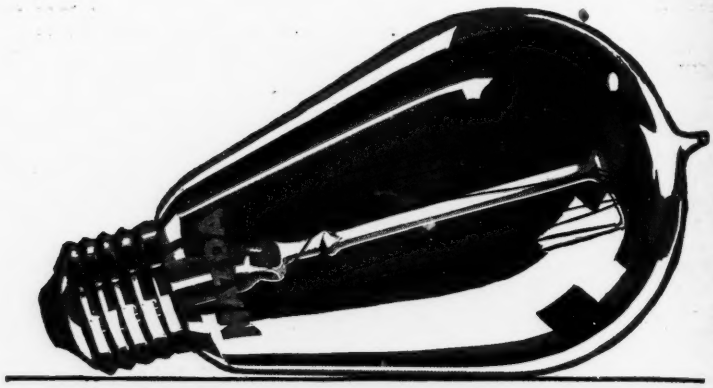
We Want Agents and Dealers

We want LIVE WIRE representatives to handle AMERICAN HAMMERED PISTON RINGS in exclusive territory. You have the benefit of National Advertising to back you up, plus the recommendation of Pierce-Arrow, Chalmers, Winton, Mercer, Stearns, Lozier, International, White, Kelly-Springfield and others. This is the best and foremost piston ring proposition on the market today and you should lose no time in getting in touch with us if you mean BUSINESS. Write us now for full particulars.

Illustrated Booklets, "The Soul of the Motor" and the "Story of the Magic Ring" Sent Free

AMERICAN PISTON RING COMPANY 906 So. 11th Street, NEWARK, N. J.

Scientific study coupled with practical manufacturing methods—this is the basis of the MAZDA Service that helps lamp-makers produce better lamps.



MAZDA

"Not the name of a thing, but the mark of a service"

The Meaning of MAZDA

MAZDA is the trademark of a world-wide service to certain lamp manufacturers. Its purpose is to collect and select scientific and practical information concerning progress and developments in the art of incandescent lamp manufacturing and to distribute this information to the companies entitled to receive this Service.

MAZDA Service is centered in the Research Laboratories of the General Electric Company at Schenectady, New York. The mark MAZDA can appear only on lamps which meet the standards of MAZDA Service. It is thus an assurance of quality. This trademark is the property of the General Electric Company.

RESEARCH LABORATORIES OF GENERAL ELECTRIC COMPANY

4638

Gillette

The Armies of the World Use the Gillette Safety Razor

WAR is the great test of any article of utility. The soldier's kit is reduced to actual necessities.

You can't imagine a soldier carrying 'round a strop and hone.

The official Army Regulations of all Countries now call for a clean shave.

And beyond all question the Gillette is the Razor of the Great War—of all the Armies, on all Fronts.

Gillette Razors and Blades have gone abroad in a continuous stream of shipments from this Country by thousands, by hundreds of thousands and by millions!

One recent shipment was 80,000 Razors and 600,000 dozen Blades.

They've gone by Atlantic Passenger Steamers—by Freight—by International Parcels Post. By first-class registered mail and they've gone as personal baggage with passengers.

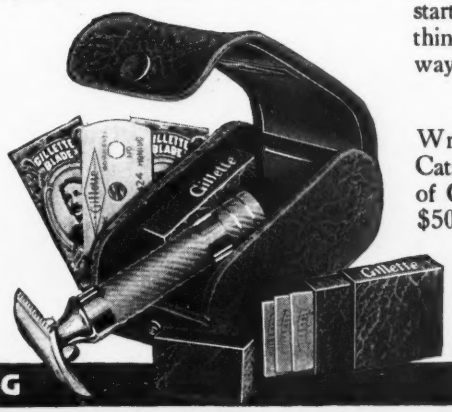
They've gone by Pacific Steamers to Japan and through Manchuria, then via the Trans-Siberian Railway to Russia.

Isn't there a lesson in this for every man in America who has not yet adopted the Gillette?

There are thousands of young men just coming to shaving age. The Gillette will help them to form good habits—the saving of small sums that count up to big ones—the habit of getting started on time—of doing a thing perfectly in the quickest way with the fewest motions.

If You Live in Canada—write the Gillette Safety Razor Company of Canada, Ltd., 73 St. Alexander St., Montreal, for Canadian Catalogue and Prices.

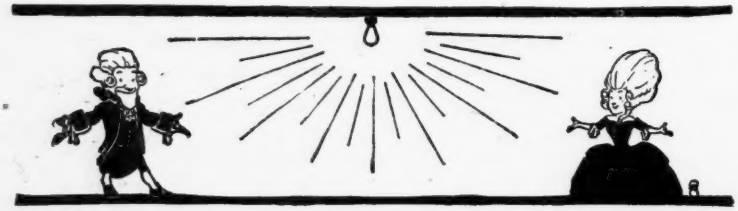
Milady Décolleté is the dainty little Gillette used by the well-groomed woman to keep the underarm white and smooth.



Write for the New Gillette Catalogue. See the thirty styles of Gillette Safety Razors, $5 to $50.

GILLETTE SAFETY RAZOR COMPANY
BOSTON, U. S. A.

NO STROPPING NO HONING



Our Felicitations

to the members of the Electrical Industry attending the Fortieth Convention which has been held during the thirty years of the organization of the

National Electric Light Association

Coming on the thirty-fifth anniversary of the organization of this country's first underground Central Station system, the Convention will give evidence afresh of the untiring efforts of the men and women who have accomplished the great achievements of the electrical industry of the United States

The New York Edison Company

At Your Service

General Offices: Irving Place & 15th St., New York City

EVEREADY DAYLO

The light that says
"There it is!"

—when all other lights fail

STORM-TOSSED and battered, helpless in a raging sea, the crew unable to launch a boat—such was the plight of the freighter, Pio IX, on the night of December 5, 1916.

And here might come the tragic end of this story, but for Antonio Oliver, one of the crew. He remembered the *Eveready* DAYLO* in his bunk; strapped it to his wrist and with ten of his comrades went overboard, clinging desperately to a ship's raft.

Gleaming like a lone star, the light from Oliver's *Eveready* DAYLO* attracted the attention of the S. S. Buenos Aires. After several failures a boat was launched and help sent to the exhausted crew. Thus were the lives of eleven men saved by the light that did not fail—*Eveready* DAYLO.*

There are times in everyone's life when a dependable pocket light is invaluable. Get your *Eveready* DAYLO* today. Prices from 75 cents up. Dealers everywhere.

AMERICAN EVER READY WORKS
of National Carbon Co. Long Island City
Canadian National Carbon Co., Limited, Toronto

**DAYLO is the winning name in our $3000 contest. We paid $3000 to each of the four contestants who submitted this word.*

when **the fuse blows and all lights go out**

when **the car stalls on a dark road and the trouble must be located**

when **uncanny scratching in an unused room awakes you**

when **someone rings your door-bell in the middle of the night**

when **a storm breaks at 2 A. M. and the windows must be closed**

when **it's too dark to see your way from the house to the garage**

when **a strange noise in the bushes near the porch alarms you**

when **the baby cries in the night**

Don't ask for a "flashlight"—get an **Eveready DAYLO**

The
World is Yours
(Military Districts Excepted)
Go where you will—Take what you please—Everything of Beauty and Current Interest belongs to you—If you take it with one of the
Seneca Cameras
The Cameras That Must Satisfy
Take home the model that pleases you. Put it to every test. If it is not the camera for you—back it goes and you get your money
Ask your dealer to show you the different Models or write today for the Free Seneca Catalog.
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Scout For 2⅞ x 4⅛ Pictures
$10

"YES, Rinex Soles *are* better than leather. They look just as well, are much more comfortable and wear decidedly longer. You'll never go back to leather soles once you wear Rinex." Sole leather, at its best, cannot compete nor compare with Rinex as a sole material. Here is the synthetic product of the world's largest rubber manufacturer, conceived and manufactured for one specific purpose—*shoe-soles*.

Rinex requires no breaking in. It is comfortable from the very beginning. It imparts the spring and swing of youth to all who wear Rinexed shoes. Rinex Soles enjoy many other advantages that will be apparent at a glance.

Next pair of shoes you buy, whether for yourself or any other member of the family, tell the clerk you want Rinex Soles. Next pair of shoes you have re-soled tell the repairman the same thing.

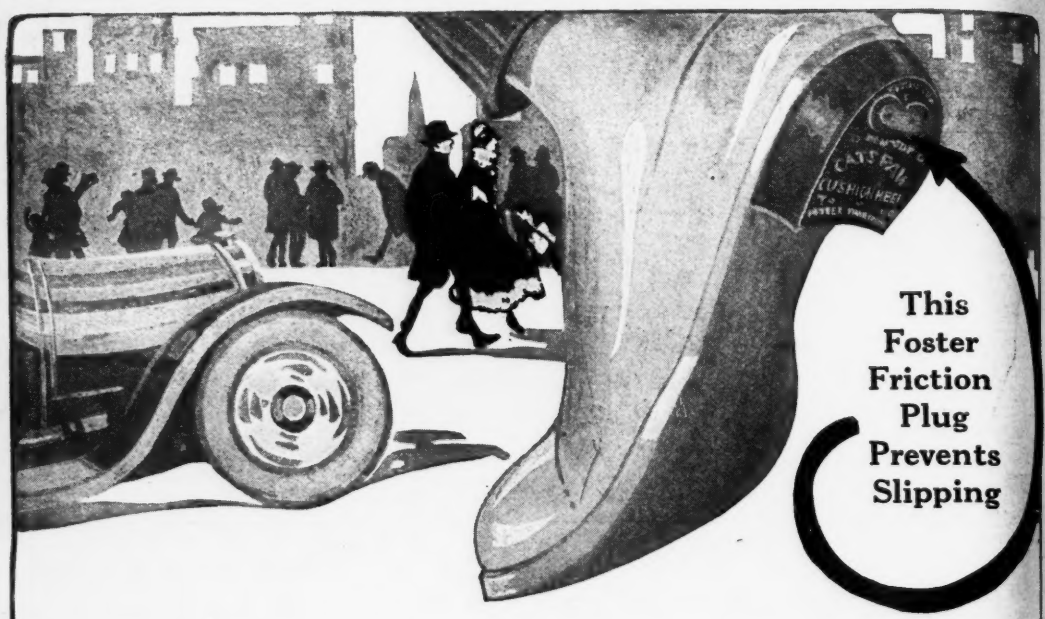
The genuine have "RINEX SOLE" stamped in the shank. Always look for this name.

United States Rubber Company

Sole and Heel Department, 1790 Broadway, New York
60 High Street, Boston

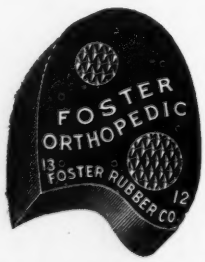
In black, white and tan at first-class shoe-stores and repair-shops.

Rinex Soles



Go along as you please on

CAT'S PAW
CUSHION
RUBBER HEELS



Do you have weak arches? Then you need the Foster Orthopedic Heel which gives that extra support where needed. Especially valuable to policemen, motormen, conductors, floor walkers and all who are on their feet a great deal. 75c attached of your dealer—or sent postpaid upon receipt of 50c. and outline of your heel.

Stop—start!—wind in and out the maze of traffic—quickly—sure-footedly.

Slipping is the biggest danger in your daily life. When your brain says, "slow down" or "step lively" there must be no foot-treachery.

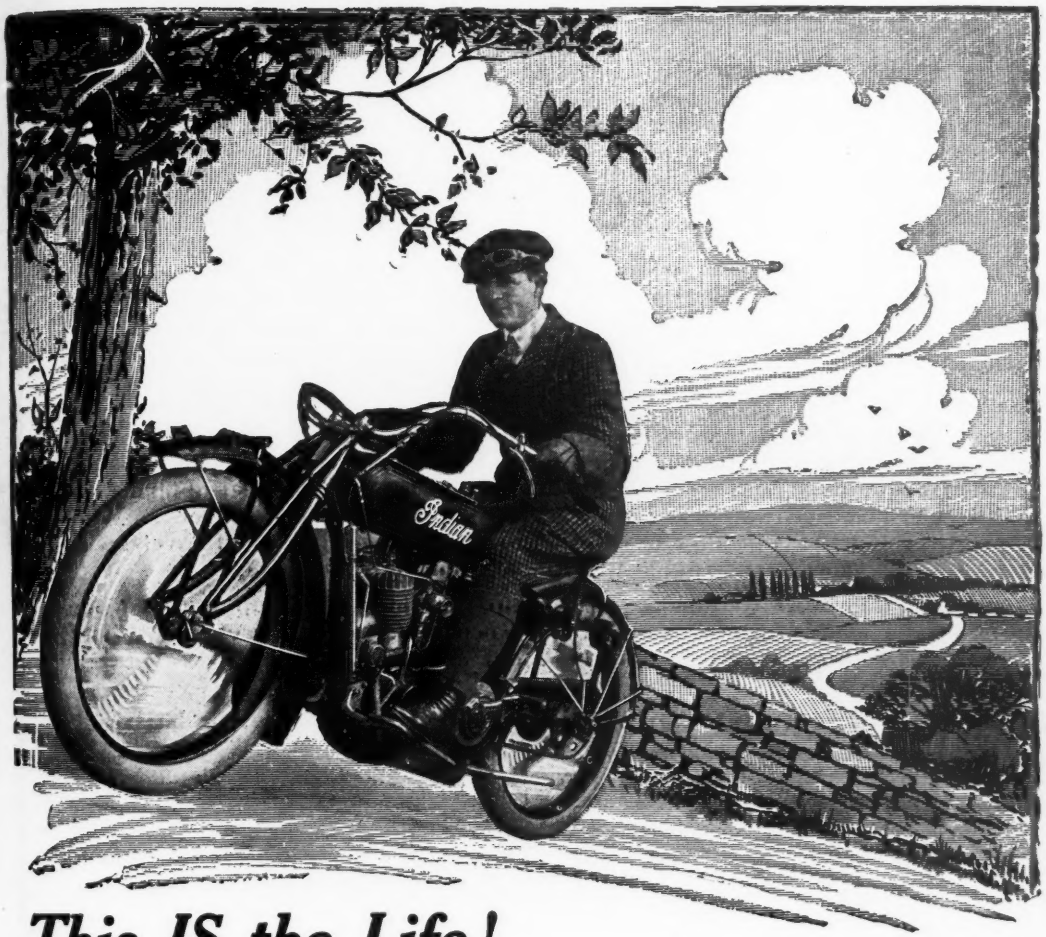
Good news, friends! The same Cat's Paws that ease your steps make walking safe. That Foster Friction Plug is the reason.

Cat's Paws contain no dirt-carrying holes, and they cost no more than the ordinary kind.

50 cts. attached—White, Tan & Gray.
For Men, Women and Children.

FOSTER RUBBER CO.
105 Federal Street - - Boston, Mass.

Originators and Patentees of the Foster Friction Plug which prevents slipping.



This IS the Life!

Motorcycling is just motorcycling until *you yourself* start the motor, get in the saddle, advance the gas, and gently engage the clutch. An instant—then the supreme thrill of feeling, for the first time, the quick responsiveness to your every touch of the 1917

Indian Motocycle
With Powerplus Motor

Away you go—through cities and towns, up hills, into valleys—wherever you *want* to go—beneath you a motorcycle built for greatest duty and almost human in its faithful, constant *fulfillment* of that duty.

Pictures galore and entertaining description of Indian Powerplus in the 1917 Indian Catalog. Send for it.

Makers also of the 1917 Indian Light Twin Motorcycle, Side Car, Electrically Equipped Bicycle and ten other model Bicycles.

HENDEE MANUFACTURING CO., 844 State Street, Springfield, Mass.

(Largest Motorcycle Manufacturers in the World)

How To Make Things Electrical

Complete Directions For Building Over 100 Pieces of Electrical Apparatus, Together With a Series of Experiments

A Workshop Manual for the student or experimenter showing the construction of everything electrical, from a simple battery cell to an electric starter for a balky horse. Shows you how to make such useful household appliances as Motors, Electric Toasters, Stoves, Clocks, Bell Transformers, Immersion Water Heater, Soldering Iron, etc., in addition to a wide range of new and novel devices that every experimenter would like to know how to make.

No other work contains in such compact form as many up-to-date designs of apparatus that can be made by the experimenter of ordinary ability. Only ordinary tools are required to do the work.

Contains Complete Information on the Following Subjects

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Clear, concise directions and careful drawings are features of this book that should not be overlooked

200 Pages, 184 Illustrations, Price $1.00

BOOK DEP'T, POPULAR SCIENCE MONTHLY

239 Fourth Avenue, New York City

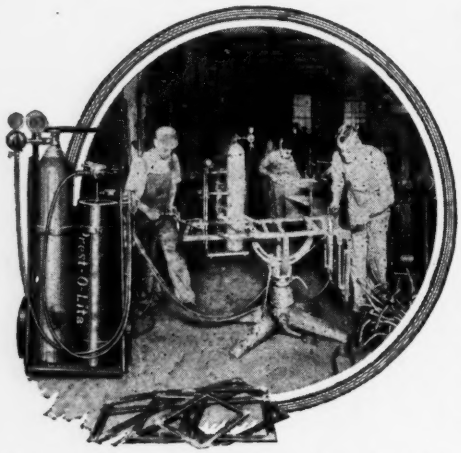
Boys! Here's the Bug. Get it!

Last month we asked you if you wanted a beautiful green-gold scarf-pin free? We also told you to watch for the answer here this month, 'member? Well, the answer is: Send in your full name and address, and the name and address of a bicycle dealer near you, to us and we will give you full instructions where to go to get this lovely stick-pin free. No boy who loves bicycling will want to be without one. Write TO-DAY.

UNITED STATES TIRE COMPANY

1793 Broadway, New York

Oxy-Acetylene Welding and Cutting



Prest-O-Lite Oxy-acetylene Process is used in the manufacture of hospital furniture by the Max Wocher Co., of Cincinnati.

Makes better, neater metal furniture at lower cost

TODAY the leading makers of all kinds of metal furniture—for offices, hospitals, homes and laboratories—employ oxy-acetylene welding instead of bolts and rivets.

By this welding process the finished product is made better, neater and stronger. Production is simplified, and other striking economies are obtained.

Oxy-acetylene welding is used as a production process by thousands of American industries—wherever two pieces of metal are to be joined it offers decided advantages. Many factories have even made radical changes in the design of their products to reap the economies of oxy-acetylene welding and increase efficiency in manufacturing methods.

In the manufacture of metal products of any kind, no matter what process you now employ, oxy-acetylene welding merits your careful investigation.

Prest-O-Lite PROCESS

Employs both gases (acetylene and oxygen) in portable cylinders. Prest-O-Lite Dissolved Acetylene (ready-made carbide gas) is backed by Prest-O-Lite Service, which insures prompt exchange of full cylinders for empty ones. Provides dry, purified gas, insuring better welds, quicker work, and lower costs, and also avoids the large initial outlay and heavy depreciation incurred in making crude acetylene in a carbide generator.

Necessary equipment is not expensive. We furnish high-grade welding apparatus for $75 (Canada $100); acetylene service at additional cost. Adaptable for oxy-acetylene cutting by the addition of special cutting blow-pipe. Thorough instructions are furnished free to every user of Prest-O-Lite Dissolved Acetylene—any average workman who understands metals can learn the process quickly and easily.

Our illustrated literature fully describes the oxy-acetylene welding and cutting process and shows hundreds of profitable applications. Write for it today.

Big profits for repair shops in job welding

Repair shops and service garages are making big profits and saving money for their customers by using oxy-acetylene welding to make broken or worn metal parts good as new. These profits you can realize. The cost of necessary equipment is low. The big growing demand for job welding insures continuous profits. Write today and get full details of our proposition.

The Prest-O-Lite Co., Inc. U. S. Main Office Factory: 830 Speedway, Indianapolis
Canadian General Office, Dept. A. D., Toronto, Ontario

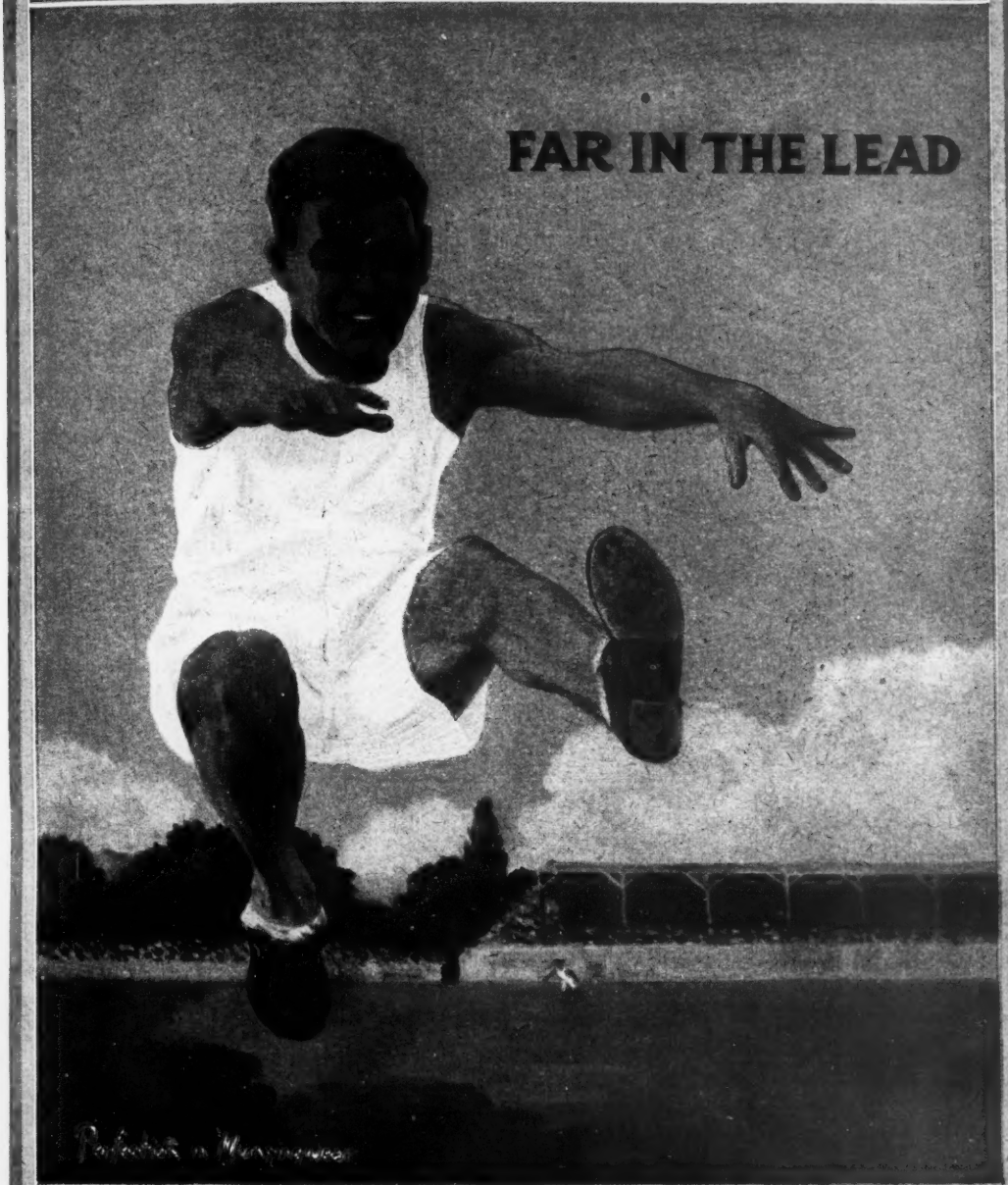
55 Branches and Charging Plants in Principal Industrial Centers

The World's Largest Makers of Dissolved Acetylene

PERFECT FITTING

MUNSING WEAR

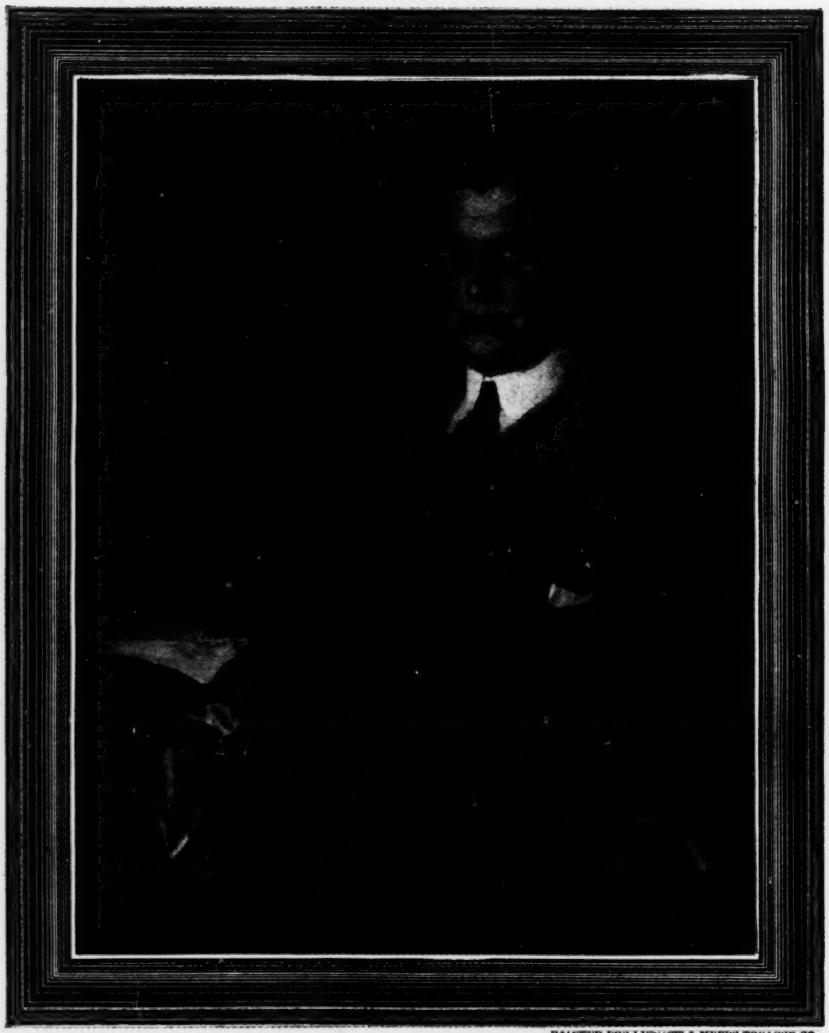
UNION SUITS



Munsing Union Suits In Summer Styles That Weigh Only A Few Ounces.

Fine in Quality, Non-Irritating, Long Wearing, Always Perfect Fitting. The fit won't wash out. The most in demand because the most satisfactory. Offered in either knitted or woven fabrics. Remember

DON'T SAY UNDERWEAR—ALWAYS SAY MUNSINGWEAR.



PAINTED FOR LIGGETT & MYERS TOBACCO CO.

TODAY, "big" men—young as well as old—know that it is worth while to give some thought even to what they smoke.

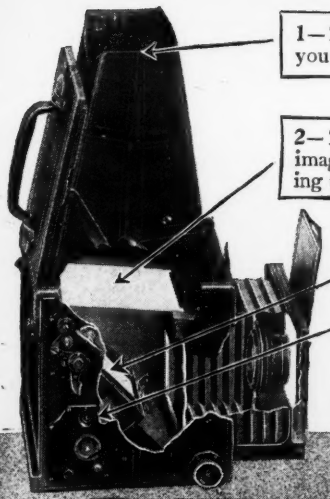
Of course, Fatima is not the only cigarette chosen by these men; but it perhaps comes nearer to it than any other.

This is doubtless because men find that, even though they may smoke more often than usual, Fatimas still leave them feeling keen and alert. Fatimas are rightly called "sensible."

Liggett & Myers Tobacco Co.

FATIMA

A Sensible Cigarette



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2—*The Ground Glass Screen* where you watch the image full negative-size—focusing it exactly, adjusting the composition up to the instant of exposure.

3—*The Swinging Mirror* which reflects image in full negative-size onto the ground glass screen.

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GRAFLEX Camera

WHY with a GRAFLEX you are ready, *instantly*, to take that picture which you may never have another chance to get—how *all* of your film or plate is *uniformly* exposed, during the *entire* exposure—and why the GRAFLEX takes GOOD pictures in sun or shade, indoors or out, is told on pages 3, 4 and 5 of the 64-page GRAFLEX Catalog. Get a copy from us or your dealer.

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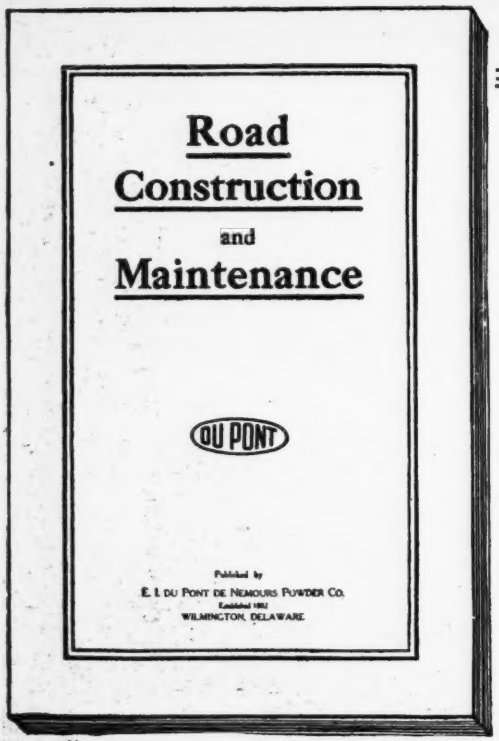
Eastman Kodak Company
Rochester, N. Y.



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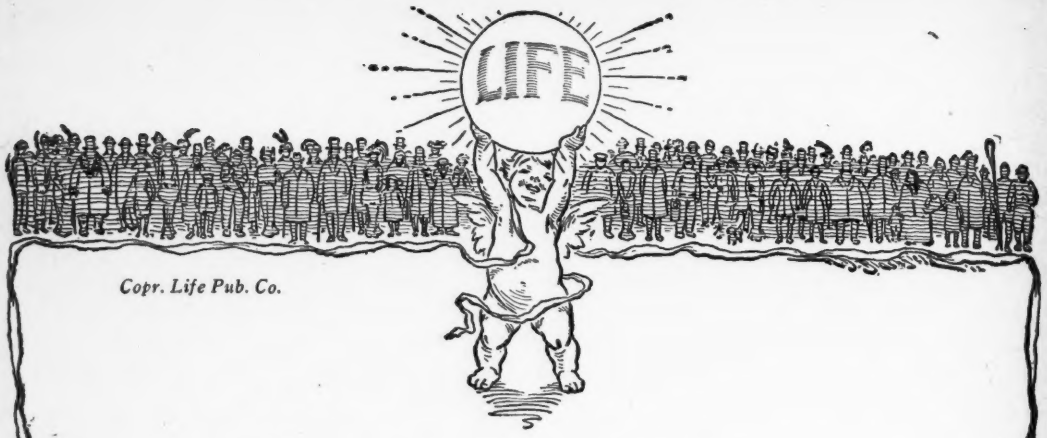

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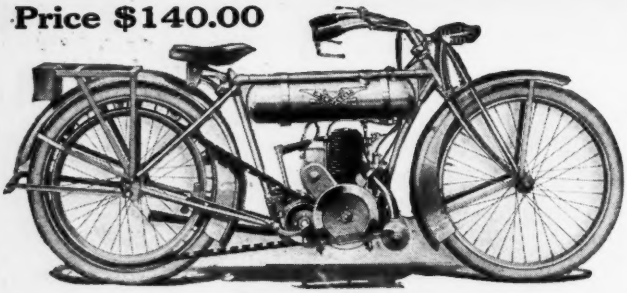

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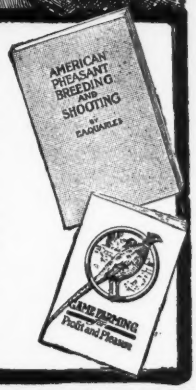

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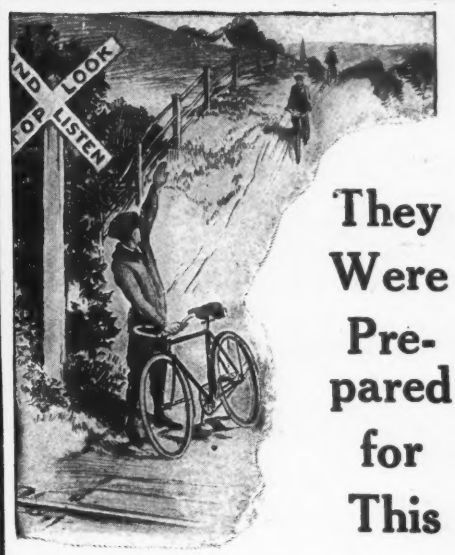

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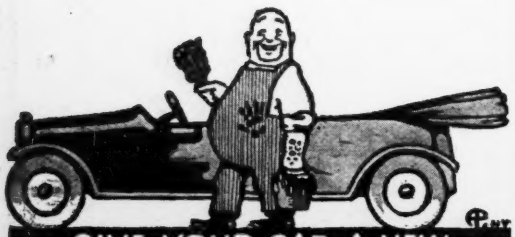

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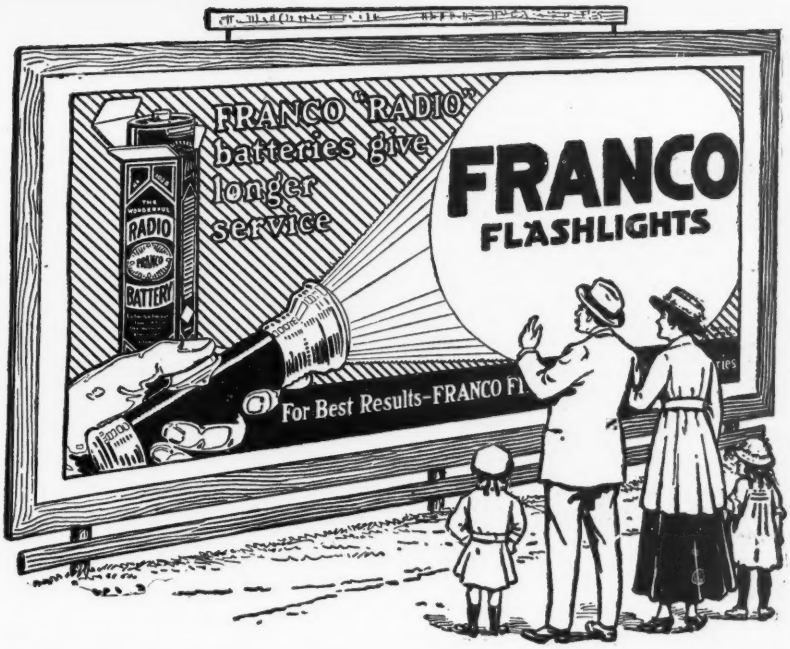

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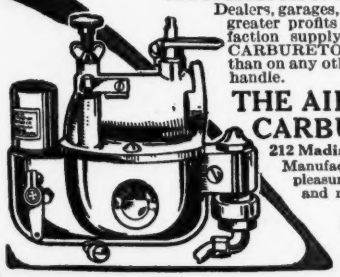

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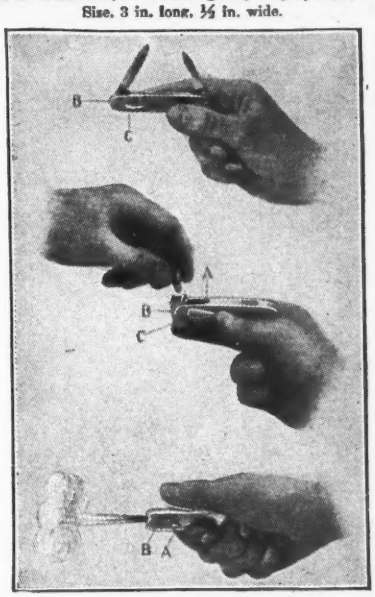

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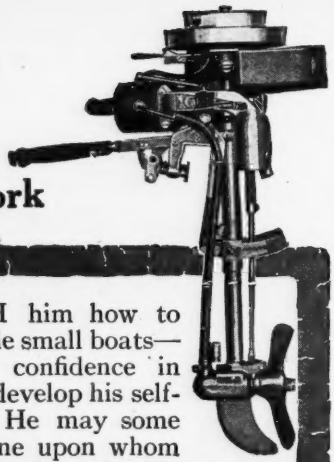

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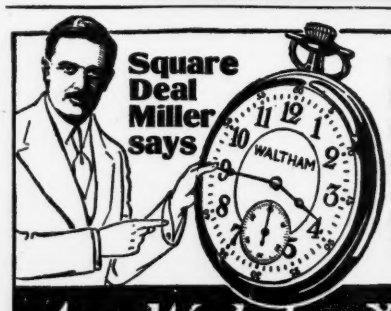

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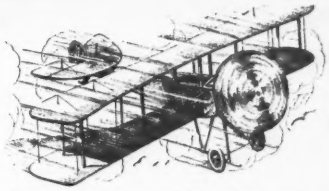

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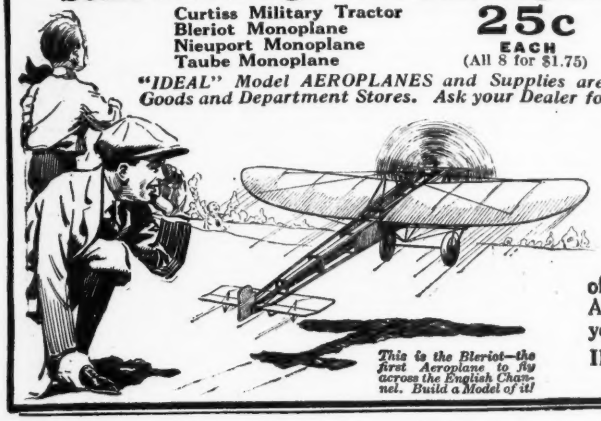

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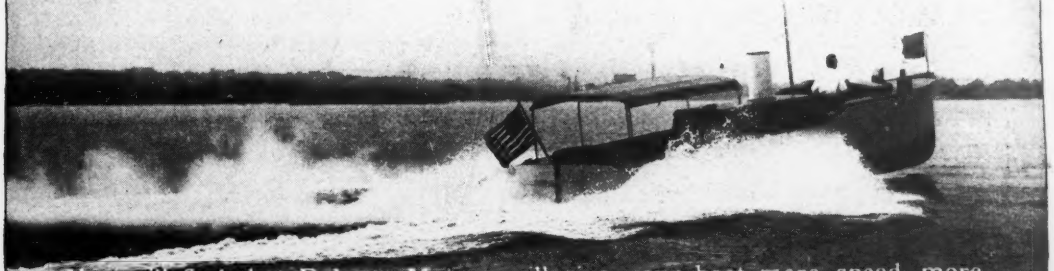

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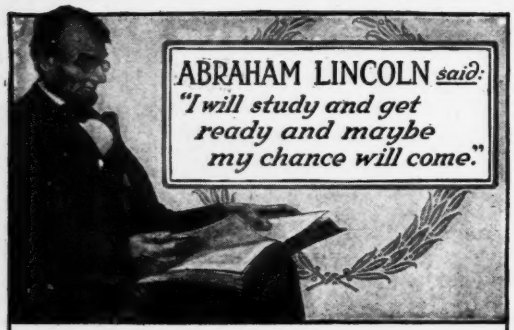

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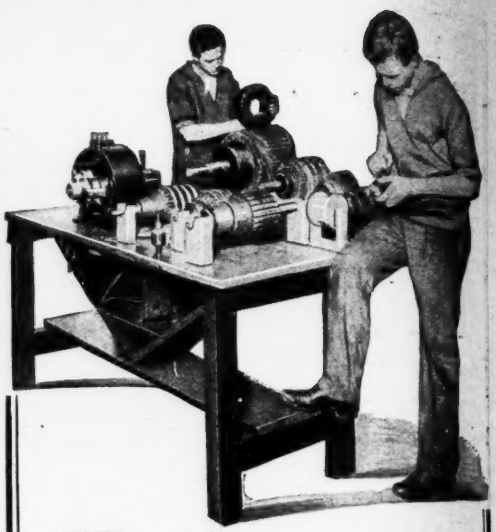

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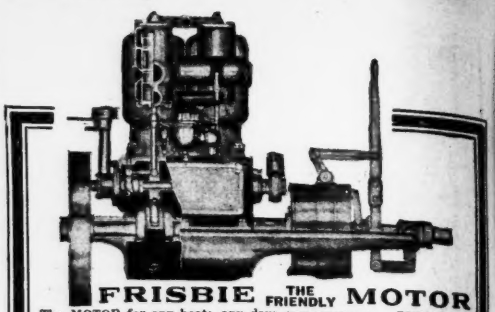

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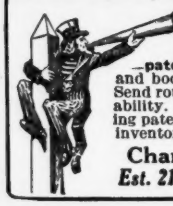

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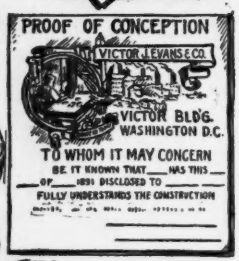
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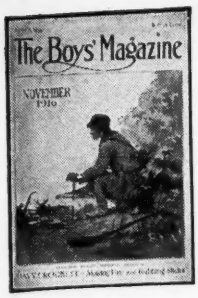

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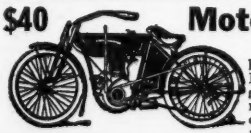

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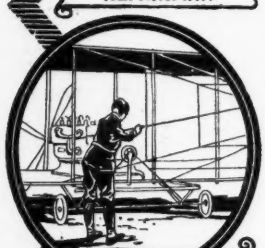

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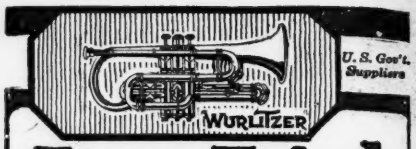

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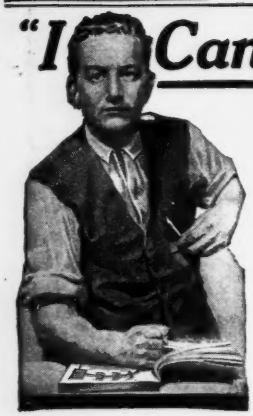

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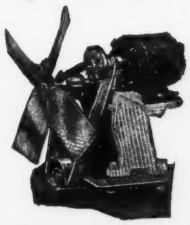

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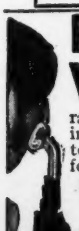

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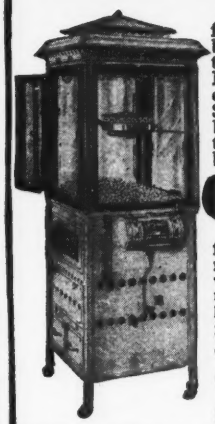

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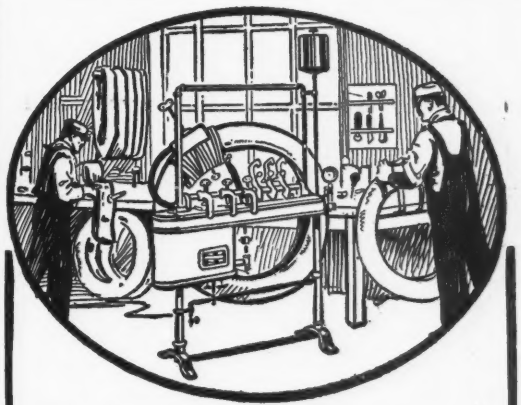

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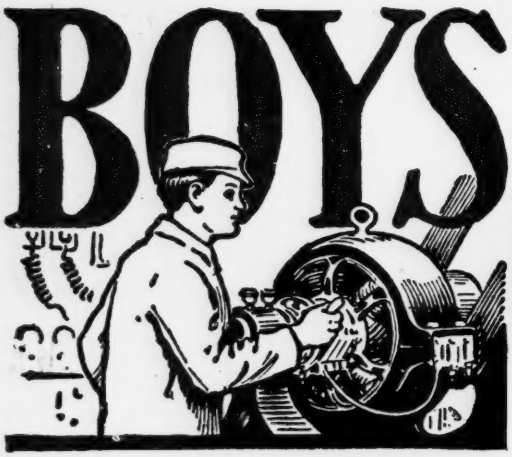

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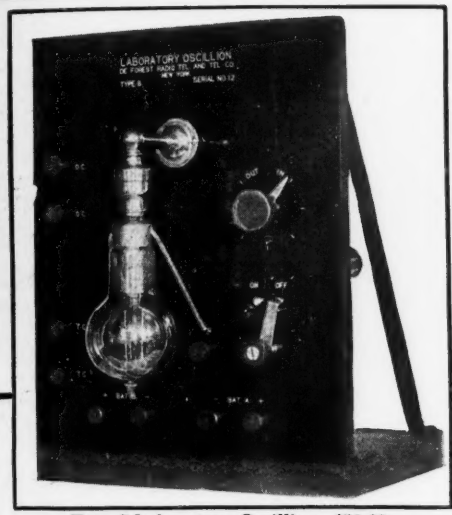

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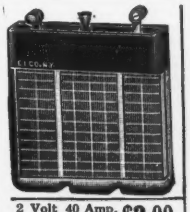

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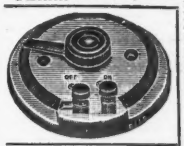

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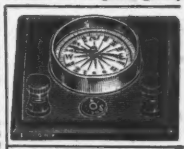

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The Expo loads in daylight with 10 or 25 Exposure Films, costing 15c and 25c respectively, and thus the picture taking part of a whole day's outing may be had for a very nominal sum — One cent a picture.

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It is simplicity itself to operate. Takes pictures through the stem, where the Rapid Fire Lens is located. The photos (5/8 x 7/8) may be enlarged to any size.

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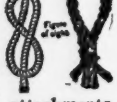

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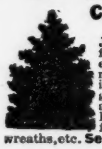

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Just introduced; noted for its rapid growth. An exceptionally pretty ornamental plant. Foliage is rich dark green. Forms grand pyramidal bushes about five feet high. Branches very desirable for decorative purposes, wreaths, etc. **Seeds 15c pkt., 3 for 40c**

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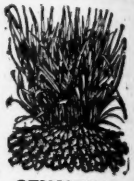
NATURE'S WEATHER PROPHET

By mysterious changes that take place, this remarkable plant accurately forecasts the weather many hours in advance. Will grow anywhere all the year around. An interesting house plant. Bears large, fragrant, pink, butterfly shape flowers. **Seeds, 15c packet, 3 for 40c, postpaid**

GROUND ALMONDS



Amazingly Prolific—Easily Grown From Seed

The Ground Almond has a flavor that is MOST EXCELLENT, resembling the cocoanut. The meat is snow white, covered with a shell or skin of brown color. It grows close to the surface and anything from 200 to 300 Almonds may be expected from a single nut. There is no trouble whatever in growing anywhere and in any kind of soil. May be planted any time, and in eight or ten weeks from time of planting you will have an ENORMOUS CROP of the MOST DELICIOUS ALMONDS YOU EVER TASTED. **Seeds, 15c. Pkt.**

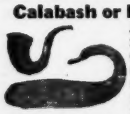
Perfume Plant

Blooms only at night, giving forth the most delightful scented fragrance for quite a distance. Causes much comment. For house or garden. Also valuable because of rare perfume made from it. **SEEDS, 10c pkt., 3 for 25c.**

SENSITIVE PLANT

Marvel of the Philippines. Leaves curl, fronds droop when touched. Apparently resents interference. A handsome shrub for house or garden; very curious and interesting. **SEEDS, 15c pkt., 3 for 40c.**

Calabash or Pipe Gourds

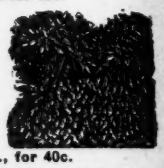


A luxuriant and rapid growing climber; thrives anywhere. Produces the ornamental gourds from which the famous African calabash pipes are made. Grow this interesting vine and make your own. **Seeds,** with full instructions, **15c. 3 pkts. for 40c.**

Japanese Nest Egg Gourd

Very curious. Produces fruit same size, shape and color of nest eggs. Matured fruit does not crack. Will serve for years as a nest egg, stocking darner, ornamental purposes, etc. **SEEDS, 15c pkt., 3 pkts. for 40c.**

MAMMOTH PEANUTS



Peanuts can be easily cultivated. Their culture is very simple and exceedingly interesting. Mammoth Peanuts grow to an astonishing size. It is a good producer, very prolific, and the **giant nuts** have a thick, heavily ribbed protecting shell. The plant is very attractive, the leaves being of odd shape and a handsome green shade, tinted through the center with white. You will derive much pleasure cultivating this interesting species. **SEEDS, 15c pkt., 3 pkts., for 40c.**

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New. Can be eaten raw as a salad, or cooked same as other cabbage. Much nicer flavor and tenderer than ordinary cabbages. Grows 15 to 18 inches high. Creates quite a sensation wherever grown. **SEEDS, 15c, 3 pkts. for 40c.**

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Unusually strong and vigorous growing vine. Attains twice the size of ordinary varieties. Grows readily on fences, poles, trellises, etc. One hill will keep an entire family supplied all summer. **SEEDS, 15c, 3 pkts. for 40c.**

HERE ARE A FEW OTHER SEED NOVELTIES YOU SHOULD CULTIVATE: Price 15c packet

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Curious Ferns (grown from seed)	Snake Cucumber	Enormous Sweet Peas
Bird of Paradise Flower	Emerald Isle Kale	Snowball Cauliflower
Japanese Hop Vine	Famous Passion Flower Vine	Mexican Firefly Plant
Castor Oil Plant	Fuchsias	Butterfly Pea
Ornamental Cotton	Ornamental Gourds	Matchless Giant Tomato
	Bouquet, or Red Cluster Pepper	Grand Rapids Lettuce
		Giant Spider Plant
		Great Banana Plant

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NITTO'S PLANT FOOD is clean, odorless, and highly concentrated. It is used in liquid form on all kinds of plants, shrubs, roses, ferns, bulbs, berries, lawns, fruit, flower and vegetable gardens. It changes ill-nourished plants into LUXURIANT BEAUTIES, producing masses of blooms that will equal any. **Causes plants to bloom early and ahead of others.** Your friends will marvel at your success. Makes no difference how healthy or how delicate your plants may be, Nitto's Plant Food will bring out **New Foliage and Flowers,** and cause a **Marvelous Transformation. 15c, 3 for 40c**

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DISSOLVING INK A new kind of invisible and vanishing ink combined. Writing is quite invisible, but can be made to appear or disappear at will in a very simple yet mysterious manner. Same **PRICE, 15c postpd.**

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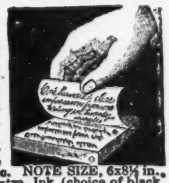
A really efficient apparatus at a very low price



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Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an exorbitant price, we have at last succeeded in producing this remarkable LUMINOUS PAINT, which, applied to the surface of any article, **emits rays of white light,** rendering it **perfectly visible** in the dark. THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES. Quite simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can coat the push buttons or switch plates of your electric lights, match boxes, and innumerable other articles; make your own Luminous Crucifixes, Luminous Rosaries, etc. Bottle containing sufficient to coat, several small articles, **Price 25c.** Larger sizes **50c** and **$1.00** postpaid.

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Stops a leak in a minute

The finest repairer for Ironware, Agateware, Enamelware, etc. Good for kettles, pots, pans, boilers, and every kind of ironware, also for tin, copper, aluminum, ice boxes, iron pipes, cracks in stoves, broken china, porcelain, bric-a-brac, bisque, crockery, woodenware, marble, etc. Will not chip, fry, burn, bake or boil out. THE MEND IS THE STRONGEST SPOT IN THE POT. Could not be simpler: just mix the powder with water. HARDENS LIKE IRON. Fire-proof, Water-proof. You can fill a big hole or a small crack. Mended place stronger than new. Replaces chipped enamel. Anyone can do it; FAILURE IS IMPOSSIBLE. Better and easier than solder. Three sizes, **15c, 25c, and 50c.**

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Better and more effective than Rubber Erasers. Simply dip reverse end of penholder in fluid and apply to the blot or error. The fluid absorbs the ink, then dry off with blotting paper, and the thing is done, leaving no trace of the blot. Of special value for thin paper. **Price, 15c bottle, 3 for 40c postpaid.**

Magic Transfer

A process for transferring pictures, engravings, etc., in their original colors, from newspapers, books, etc., to album or elsewhere. Several copies may be made. Butterfly and moth wings can also be reproduced, and an instructive collection preserved in a scrap book. Process is very simple and highly interesting. **10c, 3 for 25c, postpaid.**

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Automatic Repeating Rifle

Fires 20 Shots in One Loading

Only 25c Postpd

This is a regular size automatic revolver. Shoots B. B. shots obtainable anywhere, same as other rifles and guns. **Repeats 20 times with one loading.** Handsomely finished in gun metal. No caps or load necessary, as it works with a spring and shoots with rapidity and accuracy. Simply load with 20 B. B. shot, then press the trigger. Nothing to explode — absolutely harmless and safe. Remember, it is not a mere toy, but the same size and shape as a REGULAR AUTOMATIC. Sent complete with a round of shot for ONLY **25c** postpaid. Extra shot, **10c** a package.

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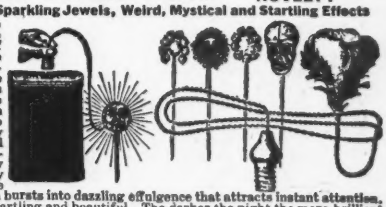
A SENSATIONAL NOVELTY

Flashing Gems, Sparkling Jewels, Weird, Mystical and Startling Effects



When wearing one of these you become "the observed of all observers," "the cynosure of wondering eyes," the admiration of ladies and the envy of the men. As shown in the illustration, the pin is connected by a double insulated wire with the flashlight, that you carry in your pocket. By merely pressing the button the Scarf Pin bursts into dazzling effulgence that attracts instant attention. The effect is both startling and beautiful. The darker the night the more brilliant the illumination appears. The Fins and Flowers may be worn without being illuminated, and they are very attractive. Assorted designs, including Skull, Horse Shoe, Pearl, Colored Stone Cluster, Flower, Auto Lamp, etc. **Price (not including Flashlight), 75 cents each. Flashlight for use with above, 75c.**

SILK FLAG PINS

3 for 5c.

Wear the colors and show your patriotism. The flags are made in bow shape of silk ribbon, with pin for sticking into coat or dress. **3 for 5c, 12 for 20c.**

AMERICAN FLAG GUM STICKERS

These Flags are about same size as a postage stamp. Gummed on the reverse side ready for use. Use them on your envelopes, stationery, etc., and let everyone know you are an American. Put up in sheets each containing 90 flags. Tear them apart like stamps. **PRICE 10c per sheet, 3 sheets for 25c.**

NEW FLAG HOLDER

The very thing for DECORATING PURPOSES

This Flag Holder solves the problem of displaying flags in home, office, porch, show window, etc. Contains receptacles for three flags that effectively hold them in proper position, making a very **beautiful and patriotic display.** Size 3¼x1 inch. Readily attached anywhere in a moment. Also handy for various decorative purposes, such as displaying reeds, pussy willow sprays, autumn leaves, etc. **PRICE** complete with brass headed tacks, **15 cents, 3 for 40 cents.**

CALENDAR PEN & PENCIL CLIP

An excellent Clip for Fountain Pen or Pencil, preventing it falling out of the pocket, with Calendar combined. Months easily altered. Well made, nickel plated, novel, useful, attractive and cheap. **12 cents, 3 for 30 cents, postpaid.**

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Pharo's Serpents Eggs, box	10c	X Ray Novelty	10c
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Gentlemen: Our vulcanizing business is becoming better and better all the time. Keep four men going. Saturday is our big day, but Friday I cleared between **$50 and $75.** The Vulcanizing game is a good one for a fellow to follow at the beginning of his business career.

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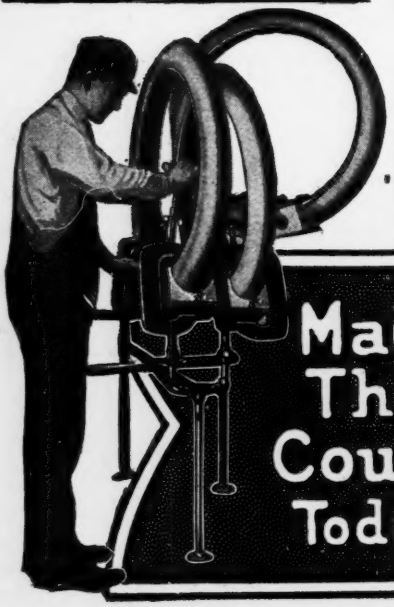

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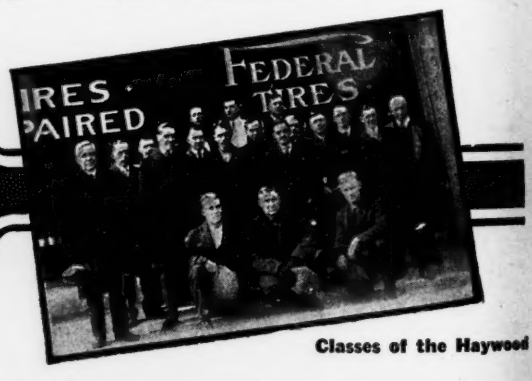

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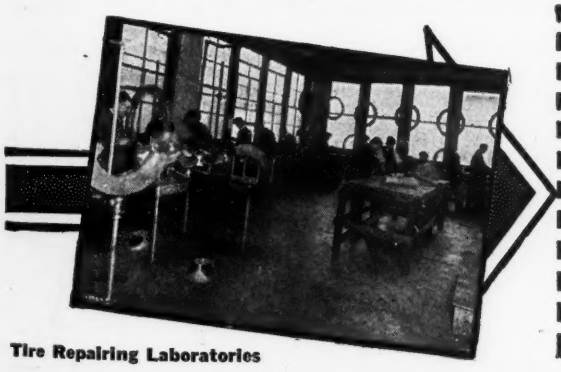

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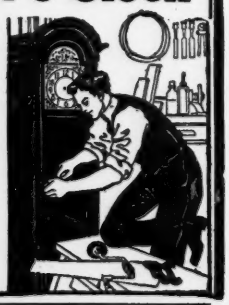

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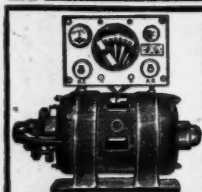

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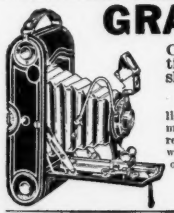

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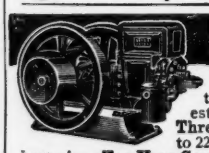

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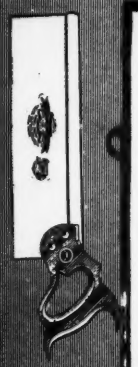

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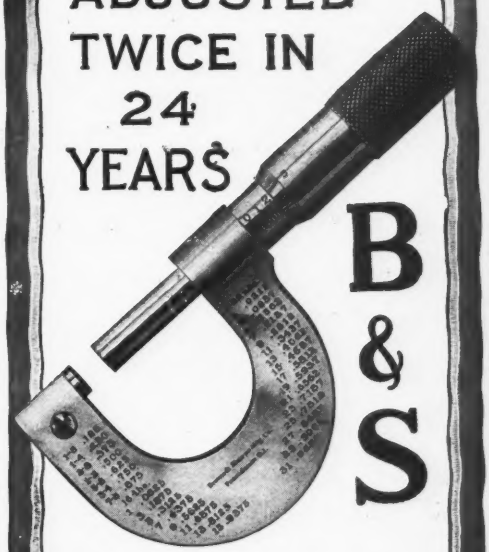

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will add, subtract, multiply, divide, solve problems involving even and uneven roots and powers. It will also give the Logarithms of numbers and the Sines, Cosines, Tangents and Cotangents of all angles.

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Threads straight pipe, bent pipe, and nipples from ¼ in. up to 2 inches; bolts from 7/16 to 1¼ in. Furnished with belt or motor drive.

Other sizes thread 1 to 4 in., 1¼ to 6 in. and 2½ to 8 in.

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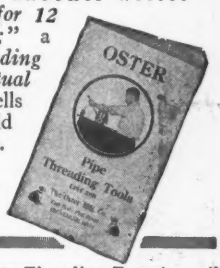

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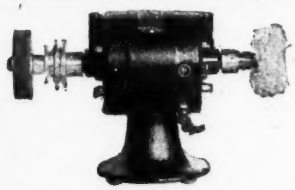

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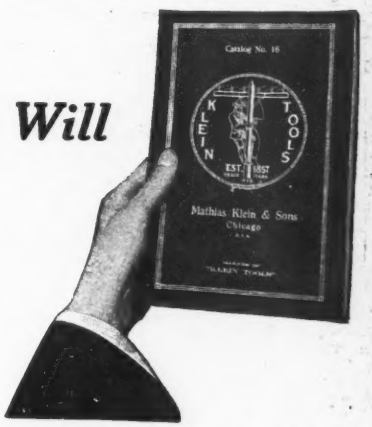

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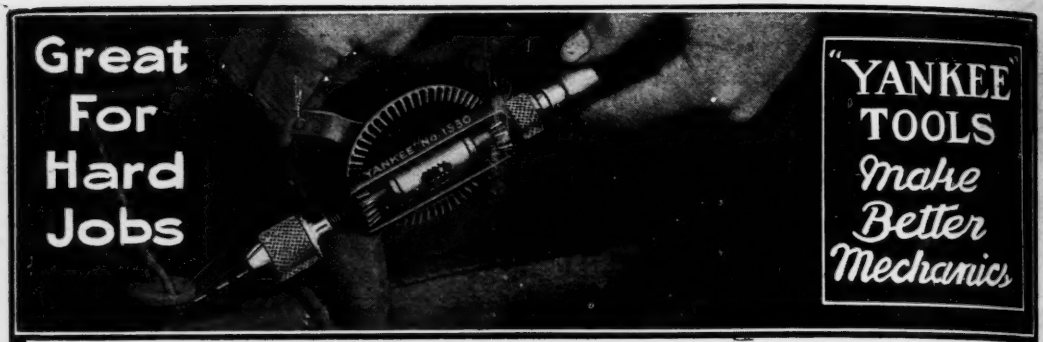

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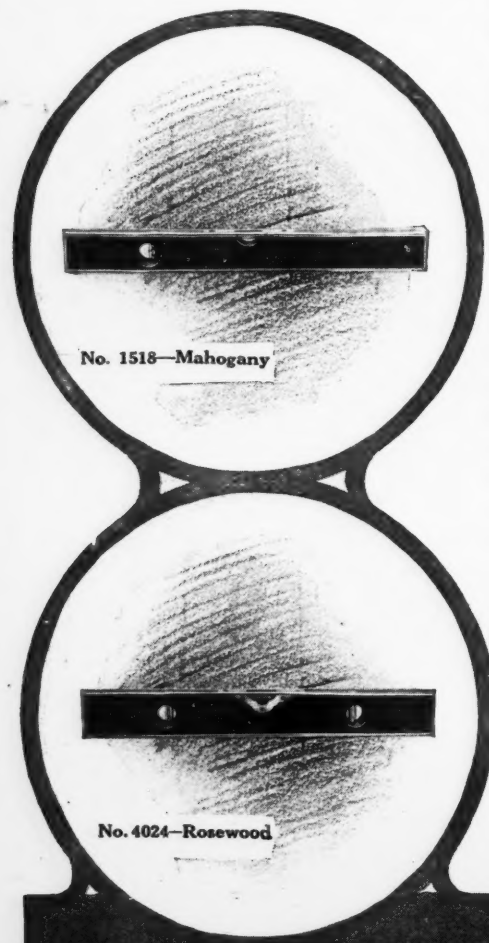

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No. 4024—Rosewood

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GOODELL-

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For Every Kind of Job

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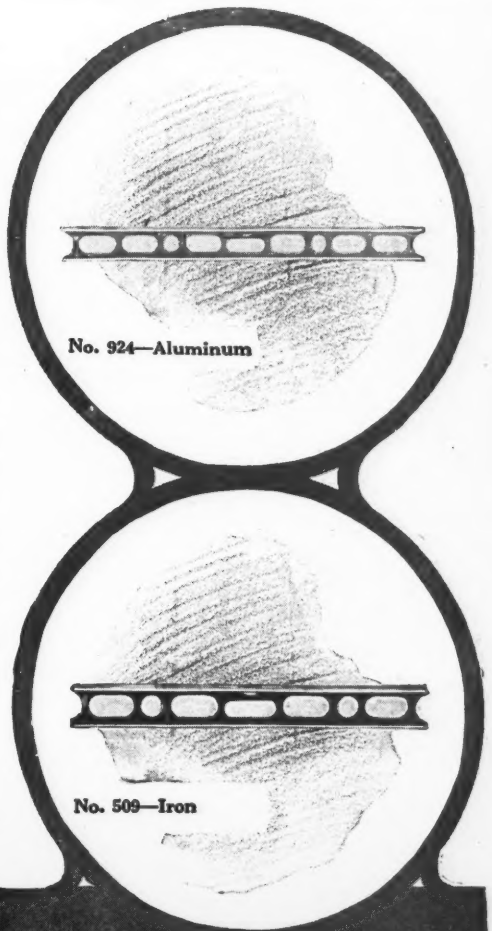
Toolsmiths **Greenfield, Mass.**

Send for the Complete Catalog, showing all the levels, and the other Goodell-Pratt Good Tools.



No. 924—Aluminum

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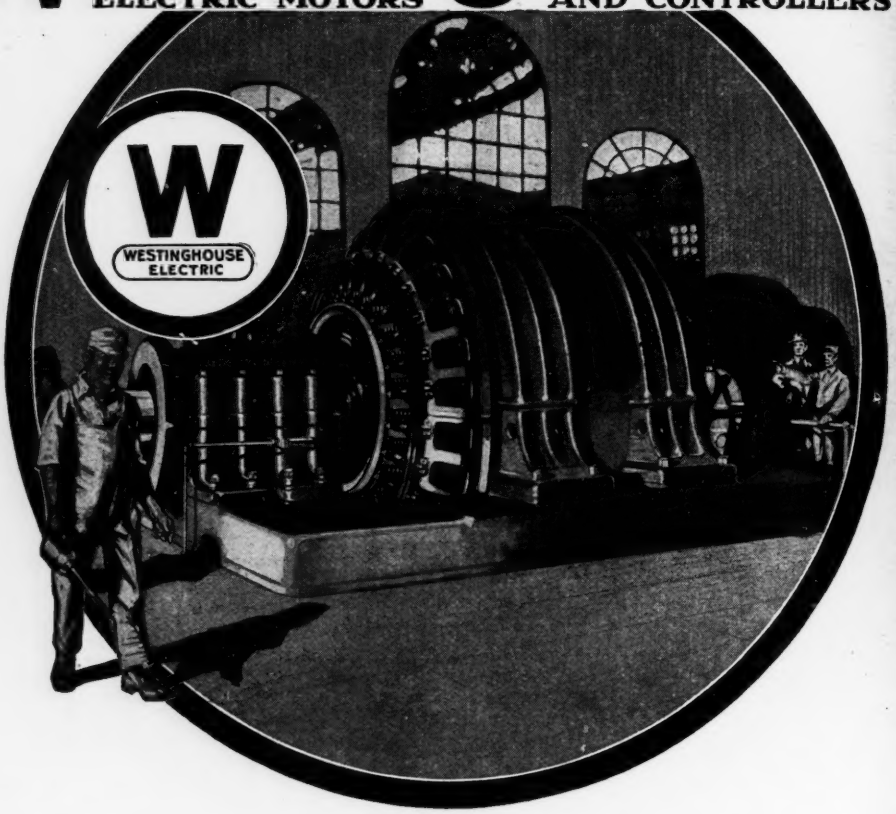

POWER and

Accuracy in the Greatest

The mighty motor that drives the steel mill and the little meter that measures the flow of current in your home present two widely different aspects of Westinghouse ability.

In achieving world-wide fame as a builder of great power units, Westinghouse Electric has never lost sight of the need for careful attention to those auxiliaries that make power-plant equipment complete.

It is as proficient in the construction of a little meter requiring all the fine workmanship of the watchmaker as in the building of a giant motor or generator.

And the list of Westinghouse electrical products includes hundreds of thousands of items, a few of which are listed on the opposite page.

Westinghouse

ELECTRICAL SUPPLIES FOR ALL PURPOSES

PRECISION

And Quality in the Smallest

Ammeters	Instrument Transformers	Choke Coils	Outdoor Metering Equipment
Voltmeters	Ammeter Shunts	Automatic Voltage Regulators	Control Desks
Wattmeters	Enclosed Fuses	Speed Limit Devices	Switchboards
Frequency Meters	Railway Fuses	Motor Control Apparatus	Electrically Operated Switches
Synchronoscopes	Knife Switches	Automobile Ignition	Line Material
Power Factor Meters	Safety Switches	Automobile Starting Motors	Arc Lamps
Reactive Factor Meters	Railway Switches	Automobile Lighting Generators	Outdoor Lighting Systems
Graphic Meters	Time Switches	Tire Vulcanizers	Electric Fans
Portable Instruments	Carbon Circuit-Breakers	Power Motors	Automatic Cooking Ranges
Curve Analyzers	Oil Circuit-Breakers	Automatic Motor Control	Sewing Machine Motors
Speed Indicators	Railway Circuit-Breakers	Battery Charging Rectifiers	General Household Motors
Watthour Meters	Railway Motors	Distribution Transformers	Turbo-Generators
Temperature Indicators	Railway Control	Outdoor Switching Equipment	Engine Driven Generators
Protective Relays	Lightning Arresters		Automatic Stokers

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
East Pittsburgh, Pa.

When writing to Advertisers please mention Popular Science Monthly

JOHNSON'S PREPARED WAX

Now Made in Liquid Form

We are now making Johnson's Prepared Wax in ***Liquid Form*** as well as Paste—so that it may be more easily polished. Johnson's Prepared Wax ***Liquid*** is exactly the same as our Paste Wax except that it is a liquid.

Is Your Car Dirty, Grimy and Unsightly?

DO you know that you, yourself, can make it look almost like new and save the cost of revarnishing? All you need is Johnson's Cleaner and Johnson's Prepared Wax ***Liquid.***

JOHNSON'S CLEANER

entirely removes all stains, scum, road-oil, tar and grease from body, hood and fenders. It doesn't injure or scratch the finest varnish—simply cleans and prepares it for the Wax polish.

Absolutely Dust-Proof

Johnson's Prepared Wax Liquid gives a hard, dry, glasslike polish which does not collect or hold the dust. It preserves the varnish and protects it from the weather, adding years to its life and beauty. It covers up mars and scratches—prevents checking and cracking—sheds water and makes a "wash" last twice as long.

Johnson's Prepared Wax Liquid is very easy to use—it polishes instantly with but very little rubbing. You can go over a good-sized car in half-an-hour.

Pints.....$.60 Half-pints.....$.35
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If your dealer cannot furnish you with Johnson's Automobile Products, we will prepay the expressage to any point in the United States East of the Rockies.

Write for our folder "Keeping Your Car Young"—it's free.

S. C. JOHNSON & SON, DepPSM6Racine, Wis.

It Does the Work the Easy Way

There are no intricacies—it is a matter of seconds to make pictures with a Premo Film Pack camera, even without previous experience.

The illustration shows how easily and quickly the camera may be loaded or unloaded. Just open the back in any light and drop in the unexposed pack or lift out the exposed one. To make the exposures, locate the subject in finder, snap the shutter, and pull out from top of pack a black tab. That's all there is to it. This operation is simply repeated until the entire pack is exposed.

Film Pack film is from the same stock as the Eastman N. C. films—an assurance of highest quality. It offers you the advantage of tank development and the unique feature of removing one or more films for development at any time, without waiting until the complete pack is exposed. Its thin, flat form and its simple principle have made possible the manufacture of unusually light, compact and inexpensive cameras, one of which is the

PREMOETTE JR.

Just a trifle larger than the pictures it makes, yet capable of as good results as those obtainable with the largest cameras.

Made of aluminum, covered with genuine leather, and fitted with Kodak Ball Bearing shutter and a choice of selected lenses, tested in the thorough Eastman way. Prices $5.00 to $14.00. Pictures 2¼ x 3¼ and 2½ x 4¼.

The new Premo Catalogue describes in detail a complete line of film pack, plate and cartridge film Premos and accessories. It's free at your dealer's, or will be sent by us postpaid on request.

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